Proposal of a system for the integrated and comparative assessment of protected areas

David Rodríguez-Rodríguez, Javier Martínez-Vega

Keywords: Protected area - Integrated assessment - Comparative assessment - Effectiveness index - SIAPA.

Abstract: Protected areas' overall goal is to achieve the long-term conservation of natural and associated cultural goods and services. However, effective long-term conservation of natural and associated cultural resources cannot always be guaranteed by a protection regime or even by effective management, as it is usually assumed. The ultimate goal of assessing protected areas is therefore concerned less with management effectiveness than with their overall long-term effectiveness. This paper describes the methodology underpinning the System for the Integrated Assessment of Protected Areas (SIAPA). The aim of SIAPA is to make the concept of 'effectiveness' operational when applied to protected areas. It is an innovative, horizontal site-level assessment system for evaluating integrally and comparably the effectiveness of terrestrial protected areas, as the assessment is based on the same parameters. Indicators are the basic assessment units. They were weighted by an expert panel and integrated into six categories (indexes) defining the effectiveness of protected areas: state of conservation, planning, management, social and economic context, social perception and valuation, and threats to conservation. These indexes were subsequently integrated into a single super-index: an effectiveness index for the protected area. Two alternative models of the SIAPA were developed: the complete model, containing 43 indicators, in order to maximize the amount of information on each protected area; and the simplified model, containing 28 indicators, in order to maximize the cost-effectiveness of the assessment.

1. Introduction

1.1. The effectiveness of protected areas

Protected areas (PAs) are 'clearly defined geographical areas, recognized, devoted and managed, through legal means or other effective means, to attain the long-term conservation of nature and its associated ecosystem services and cultural values' (Dudley, 2008). PAs are the main global conservation strategy to mitigate current biodiversity crisis (Jenkins and Joppa, 2009; Pullin, 2002). However, we might be assuming PAs are conserving effectively their natural and cultural resources merely because they have been given protection status (Pomeroy et al., 2005; Pullin, 2002).

Recent global studies have demonstrated that, despite continuous growth in the number of and area covered by protected areas (Jenkins and Joppa, 2009; McDonald and Boucher, 2011), biodiversity and other ecosystem goods and services continue to be lost (Butchart et al., 2010). It is accepted that the sole designation of an area as 'protected' does not imply that it is effectively conserved and that, in order for it to be so, it should also have effective management (Ervin, 2003; Hockings et al., 2006; Nolte et al., 2010; Pomeroy et al., 2005). But is effective management enough to achieve long-term conservation of ecosystems goods and services?

1.2. The need to assess protected area effectiveness on common parameters

The evaluation of PAs has become a priority for adaptive management and early-warning strategies in a context of global change (Alcaraz-Segura et al., 2009; Hockings et al., 2006; Pomeroy et al., 2005). One of the targets of the Programme of Work on Protected Areas of the Convention on Biological Diversity (CBD) was to adopt and implement, 'by 2010, frameworks for monitoring, evaluating and reporting protected area management effectiveness at sites, national and regional systems. . .' (Nolte et al., 2010). Currently, this target has been expanded to cover 60% of the total area covered by protected areas by 2015 (CBD, 2010).

Such evaluations often take the form of PA assessments, PA management effectiveness (PAME) evaluations or PA effectiveness evaluations, terms that are frequently used interchangeably (Ervin, 2003). As precise, sound definitions are fundamental to science (Spangenberg, 2011), some order and clarification is needed in the rapidly developing field of PA assessment.

Moreover to our knowledge, a common, non opinion-based framework for assessing and reporting the effectiveness of individual PAs from similar contexts between the level of PA network assessments and specific goal-oriented site assessments remains undeveloped,

despite its interest for PA managers, PA network managers, policy-makers and scientists.

1.3. Management effectiveness evaluation as a part of PA effectiveness evaluation

According to the most updated definition of PAs by the IUCN (Dudley, 2008), a PA can be deemed "effective" only if it is capable of conserving the entire set of nature and associated ecosystem services and cultural values it harbors in the long-term, something that effective management cannot always guarantee (Jameson et al., 2002).

Hockings et al. (2000) provided a valid, useful framework for assessing individual PAs comprehensibly (Ervin, 2003; Stoll- Kleemann, 2010). The framework has, however, linguistic and conceptual limitations.

First, the term 'management effectiveness' can be confusing for both managers and evaluators, as PAME may include context variables (Hockings et al., 2006) that are outside the means, aims or competence of PA managers, such as those related to economy, society, regional or global threats. The intensity of and trends in such variables may make on-site management efforts largely inefficient (Alcaraz-Segura et al., 2009; Araújo et al., 2011; Gaston et al., 2006; Radeloff et al., 2010), especially in the marine environment (Jameson et al., 2002).

Current PAME terminology may also be unfair to PA managers, who might be held responsible for outside circumstances that they cannot control or even influence. Furthermore, a precise PAME would exclude many protected areas, as PAME should be target-driven (Hockings et al., 2006), many PAs lack specific management goals or targets (Bertzky and Stoll-Kleemann, 2009; Paleczny and Russell, 2005; Pomeroy et al., 2005), and, when such goals exist, they are often ambiguous or even contradictory (Naughton-Treves et al., 2005).

Thus, it is doubtful that the result of an assessment within this wide framework in fact relates to 'management effectiveness'. Even if management represents an essential part of PA assessments, the core phenomenon assessed should be related less to management than to the effective long-term conservation of the goods and services provided by these areas (Bertzky and Stoll-Kleemann, 2009; Ervin, 2003; Paleczny and Russell, 2005; Parrish et al., 2003). Parrish et al. (2003) used the term 'ecological integrity' of PAs, and Gaston et al. (2006) used 'ecological effectiveness' although both approaches are strictly ecology-driven. Therefore, for the sake of scientific precision and clarity, it would be more appropriate to call an integrated approach to PA assessment that includes broad context variables a 'PA effectiveness evaluation' (PAEE), of which PAME is a crucial part. This proposed new nomenclature covers all types of PAs, regardless of the existence of effective management or management objectives.

We propose that the term 'PAME' be used only for assessment of those aspects of PAs that are directly linked to management (and, ideally, where clear management objectives have been set up), whereas 'PAEE' should be used for a wider framework, including PAME but also relevant context variables not directly linked to management and not requiring the existence of specific management objectives.

1.4. The system for the integrated assessment of protected areas (SIAPA)

In response to the need for sound environmental decision support systems (CBD, 2010; Ostendorf, 2011), the SIAPA has the following objectives: (1) to clarify the concept of 'PA effectiveness'; (2) to make the concept operational, by identifying a set of management and policy-relevant indicators and indexes for use in an integrated manner; (3) to present a common, rigorous, simple, cost-effective, adaptable assessment framework for use at site level in a wide range of terrestrial PAs and for comparing different PAs from similar contexts, regardless of their size, protection category or the type of ecosystems they include; (4) to identify the strengths and limitations of PAs for attaining long-term conservation of their natural and associated cultural resources; (5) to assist managers and decision-makers in making informed management decisions; (6) to encourage effective cooperation between administrations and among scientists, managers and policy-makers; and (7) to promote transparency and accountability in the public and private sectors.

2. Methods

2.1. Identification of indicators and categories

A first set of 105 indicators that might be meaningful for the effectiveness of PAs was identified after an initial literature review, as done for relevant variable identification in other studies (Chuvieco et al., 2010). The review covered published hard copies and online scientific and technical books and papers (non-exhaustive list provided) on conservation science (Pullin, 2002), PAs (Chape et al., 2008; Dudley, 2008), PA assessment (Hockings et al., 2000, 2006; Mallarach et al., 2008; Pomeroy et al., 2005), biodiversity assessment (Spellerberg, 1992), environmental indicators (EEA, 1999; Ramírez, 2002) and sustainable development (Jiménez et al., 2005; OECD, 1993), in both English and Spanish. Six broad categories related to the effectiveness of PAs were also identified after this review: 'State of conservation', 'Planning', 'Management', 'Social and economic context', 'Social perception and valuation', and 'Threats to conservation'.

2.2. Selection of final set of indicators

The set of potential indicators was shortlisted to a manageable final selection by removing redundancies and by consultation with experts, as in other studies (Chuvieco et al., 2010; Fraser et al., 2006; Martínez-Vega et al., 2009).

The expert panel comprised representatives of government bodies: the Division of PAs of the Regional Ministry of Environment of the Autonomous Region of Madrid (CMAOT, responsible for managing PAs in the region) and the National Ministry of Environment and Rural and Marine Affairs (MARM); research agencies: the Centre for Environmental Research of the Region of Madrid (CIAM), the Regional Foundation for Environmental Research and Development (FIDA), the Spanish Observatory for Sustainability (OSE), the Faculty of Biology of the Complutense University of Madrid (UCM), the national section of the Europarc Federation (Europarc-Spain) and the Catalan Institute of Natural History (ICHN); and environmental nongovernmental organizations: Greenpeace-Spain, SEO-Birdlife, WWF-ADENA, and Ecologistas en Acción (EEA).

Each person from the expert panel was contacted by phone, told the aim of the study and asked to score each of the proposed indicators according to their importance for assessing the long-term conservation of a PA, as 1 (minimum importance), 2 (moderate importance) or 3 (maximum importance). An excel sheet containing the 105 pre-selected indicators was subsequently e-mailed to each expert. Replies in the required format (numerical) were provided only by the MARM, the OSE and the CMAOT. A final set of 40 indicators was selected according to the scores given by these experts and by the authors. Written replies were provided by the CIAM, the UCM, the ICHN, Greenpeace-Spain and SEO-Birdlife, which were used to clarify a final selection from the numerical replies. They suggested the inclusion of a low-scored indicator, 'evolution of temperature', which was subsequently renamed and developed as 'climate change'. These replies also suggested the inclusion of two new indicators: 'landscape impact' and 'evolution of the designated area'. As a result, a final selection of 43 indicators was made.

2.3. Selection of spatial and temporal scales

Regarding space, the whole area of the PAs as defined by law (based on administrative boundaries) was selected as the reference spatial scale for the assessment. For large, zoned PAs (parks), a more detailed assessment scale (management zone) was analyzed when valuating and interpreting the indicator. The values obtained for each management zone were subsequently integrated to obtain a single value for the whole PA by giving a greater weight to the variables inside core zones than in buffer or transition zones, respectively. Thus, whereas a unique assessment scale was generally used for small protected areas (the whole PA), two complementary scales were analyzed for large protected areas when possible: management zones and the whole PA.

Regarding time, for a first assessment, we planned to assess each indicator since the legal designation of each PA. When this was not possible, we used the first available data. As a result, the period of the available rough data for some indicators differed. The period of available information for each indicator was specified. However, the same assessment date was considered for the whole system: the year in which all the available information was gathered and analyzed: 2010.

Regarding the periodicity of the assessment, we recommend that it be conducted every 4 or 5 years to balance cost-effectiveness.

2.4. Development of indicators

A detailed original profile was developed for each of the 43 effectiveness indicators selected for the complete model (CM) of the SIAPA (Table 1), based on the template developed for other site-level assessment system (Mallarach et al., 2008). The indicators are adaptable to the conditions of any terrestrial protected area, regardless of size, category or type of ecosystem. Some of the indicators are simple ones, representing one variable (e.g. 'evolution of the area designated as protected'), whereas others are composite, including several original variables to represent a complex phenomenon (e.g. 'surface water quality').

Table 1. Template for the development of indicators

Name	
Category	Sustainability category or index where the indicator is included
Type	Pressure-State-Response
Description	Object of the indicator
Rationale	Reason/s for which the indicator is important
Data source	Body providing data; origin of data
Data availability	Ease to access data
Updating	Advisable frequency for the updating of the indicator
Scale	Scale of valuation: 0 (deficient value), 1 (moderate value), or 2 (adequate value)
Calculation and Interpretation	Protocol for the measurement and valuation of the indicator. It may include additional clarifying notes as "Explanatory notes" Protocol for the consideration and valuation of the indicator. based on the scale of valuation. It may include additional clarifying notes as "Explanatory notes"
Trend	Criteria which determine the temporal evolution of the indicator
References	Bibliography or legislation justifying the selection or valuation of the indicator

2.5. Establishing thresholds

Two thresholds were chosen for each original scale of every variable, indicator and index according to the following criteria, listed in order of importance: values established by law, values commonly used by specialized agencies and values found in the literature (Barrera-Roldán and Saldívar-Valdés, 2002). In the absence of a published reference, logical, empirical or experience-based values based on the precautionary principle (Cooney and Dickson, 2005) were used to define the necessary thresholds on which to valuate the indicators (ten Brink, 2006; Moldan et al., 2012; Ramírez, 2002).

2.6. Homogenizing scales

In order to facilitate integration, interpretation of results and to compare indicator values for different PAs (Bertzky and Stoll- Kleemann, 2009), the original scales for each variable, indicator and index were adapted to a standard scale of valuation of 0 (deficient value), 1 (moderate value) or 2 (adequate value). Similar rescaling procedures have been used in other studies developing indicators or indexes (Chuvieco et al., 2010; Sun et al., 2010).

2.7. Integration of indicators into indexes

The 43 indicators were classified according to the internationally accepted pressure–state–response model for environmental indicators (OECD, 1993), rescaled and integrated into six partial indexes summarizing the broad categories defining the effectiveness of a PA that had been previously identified: 'State of Conservation Index' (SCI), 'Planning Index' (PLI), 'Management Index' (MAI), 'Social and Economic Context Index' (SEI), 'Social Perception and Valuation Index' (SPI), and the 'Threats to Conservation Index' (TCI). Two general aggregation procedures were tested: simple and weighted. The simple aggregation procedure assumes that every indicator has the same weight (importance) when integrated into one of the partial indexes. The experts' opinions and our experience showed that this was not a sufficiently justifiable option. Therefore, we opted for weighted aggregation of the indicators, as done in previous studies (Chuvieco et al., 2010; Martínez-Vega et al., 2009). Thus, the 43 indicators were weighted according to the average importance value given by the numerical replies from the experts, excluding the authors: If the sum of the scores of the three experts was 9, the indicator was weighted by 2 points; if the sum of the scores of the three experts was 8, the indicator was weighted by 1.5 points; if the sum of the scores of the three experts was <8, the indicator was weighted by 1 point.

The three indicators included in the SIAPA from the experts' written replies were given an arbitrary weight of 1 point. Thus, each indicator was introduced into the index calculation formula multiplied by the initial average weight given by the expert panel (Martínez-Vega et al., 2009): 1, 1.5 or 2 points. If an indicator could not be measured for some PAs, its value was excluded from the calculation of that index for those PAs. As a result, the indexes of different PAs are compared on the basis of the available information for each PA, which might include different groups and numbers of indicators.

2.8. Integration of indexes into an effectiveness index

In order to create a highly aggregated value that summarized the overall effectiveness of each PA for management and policy purposes (Fraser et al., 2006), an 'Effectiveness Index' (EI) was created. A second survey was conducted among the same 12 experts, excluding the authors. The experts were asked to score the six indexes according to their relevance for the effectiveness of a PA1, from 1 point (not very relevant) to 5 points (very relevant). Each of the six partial indexes was subsequently weighted by the average value given by those experts whose replies could be collected: CMAOT, MARM, OSE, ICHN, UCM and EEA (Table 2). The Effectiveness Index was calculated from this survey by summing the five rescaled partial indexes that add to the effectiveness of the protected area: SCI', PLI', MAI', SEI' and SPI', each weighted according to the mean value given by the experts, and subtracting the weighted TCI', which diminishes effectiveness.

For EI valuation and interpretation, cutoffs from the rescaled EI (EI') were empirically established on the basis of the precautionary principle (Cooney and Dickson, 2005) according to the following criteria: EI' = 2 points (adequate): the upper cutoff is the result of incorporating a value of 1.5 points for each of the first five indexes: SCI, PLI, MAI, SEI and SPI, and 0 points for the TCI: EI' ≥ (1.5 × 4.3 + 1.5 × 3.5 + 1.5 × 4.8 + 1.5 × 4.2 + 1.5 × 3.5 − 0 × 4.3)/ 24.7 = 1.2; EI' = 1 point (moderate): the lower cutoff is the result of incorporating a value of 1 point for each of the first five indexes: CI, PI, MI, SEI and SPI, and 0 points for the TCI: EI' ≥ (1 × 4.3 + 1 × 3.5 + 1 × 4.8 + 1 × 4.2 + 1 × 3.5 − 0 × 4.3)/24.7 = 0.8 and < 1.2; EI_ = 0 points (deficient): EI' < 0.8.

Each index calculation formula and its value and interpretation is shown in Table 3.

2.9. Optimization of the model

A simplified model (SM) to enhance the cost-effectiveness of the assessment was developed from the complete model (CM) of the SIAPA by further shortlisting the 43 indicators according to the original valuation by the experts, excluding the authors. Indicators summing up to less than 7 points in the original valuation were excluded from the SM. The 'climate change' indicator was included in the SM exceptionally due to its relevance for PA conservation (Araújo et al., 2011). As a result, a simplified set of indicators rep-resenting the most important ones for the effectiveness of PAs was identified. The selected indicators for the SM are marked with (a) in Table 4.

Table 2.
Index rating given by the experts

Expert	Index					
	Conservation state (SCI)	Planning (PLI)	Management (MAI)	Social and economic context (SEI)	Social perception and valuation (SPI)	Threats to conservation (TCI)
CMAOT	5	4	5	4	3	4
MARM	5	4	5	3	3	5
OSE	2	3	5	5	4	4
ICHN	5	3	4	4	3	4
UCM	4	3	5	5	5	4
EEA	5	4	5	4	3	5
MEAN	4.3	3.5	4.8	4.2	3.5	4.3
SUM	24.7					

CMAOT: Division of PAs of the Regional Ministry of Environment of the Autonomous Region of Madrid; MARM: National Ministry of Environment and Rural and Marine Affairs ; OSE: Spanish Observatory for Sustainability; ICHN: Catalan Institute of Natural History; UCM: Faculty of Biology of the Complutense University of Madrid; EEA: Ecologistas en Acción.

Table 3
Composition, calculation and valuation of the indexes included in the SIAPA.

Index	Number of indicators		Calculation formula	Value (interpretation)
	Complete model	Simplified model		
State of conservation (SCI)	6	5	$wI' = \frac{\sum_{i=1}^{n} xi \cdot ki}{\sum_{i=1}^{n} ki}$	$wI^L \geq 1.5 \rightarrow 2$ points (adequate)
Planning (PLI)	7	4		$1 \leq wI^L < 1.5 \rightarrow 1$ point (moderate)
Management (MAI)	12	6		$wI^L < 1 \rightarrow 0$ points (deficient)
Social and economic context (SEI)	5	4	where wI^L is the rescaled generic index value; xi the	
Social perception and valuation (SPI)	4	2	rescaled indicator value (0; 1; 2); ki the weighting factor	$TCI^L \leq 0.5 \rightarrow 0$ points (adequate)
Threats to conservation (TCI)	9	7	(2; 1.5; 1) and n is the number of indicators applied	$0.5 < TCI^L < 1 \rightarrow 1$ point (moderate)
				$TCI^L \geq 1 \rightarrow 2$ points (deficient)
Effectiveness index (EI)	43	28	$EI' = \frac{\sum_{j=1}^{6} wI'i \cdot li}{\sum_{j=1}^{6} li}$	$EI^L \geq 1.2 \rightarrow 2$ points (adequate)
			where EI^L is the rescaled effectiveness index value; wI^L the rescaled partial index value (0; ±1; ±2) and li is the weighting factor (3.5–4.8)	$0.8 \leq EI^L < 1.2 \rightarrow 1$ point (moderate)
				$EI^L < 0.8 \rightarrow 0$ points (deficient)

3. Results

The 43 indicators making up the CM and the SM of the SIAPA are shown in Table 4.

The detailed profiles of each indicator are provided as supplementary data.

The effectiveness of a PA (EI') can be estimated from the following formula, according to the average weight/contribution of each of the partial indexes to the EI:

$$EI' = \left(SCI' \times \frac{4.3}{24.7} + PLI' \times \frac{3.5}{24.7} + MAI' \times \frac{4.8}{24.7} + SEI' \times \frac{4.2}{24.7} + SPI' \times \frac{3.5}{24.7} - TCI' \times \frac{4.3}{24.7}\right),$$

$$\text{or } EI' = (SCI' \times 0.176 + PLI' \times 0.142 + MAI' \times 0.196 + SEI' \times 0.169 + SPI' \times 0.142 - TCI' \times 0.176)$$

4. Discussion

The SIAPA is an environmental decision support system for improving the management and conservation of PAs, primarily for the use of managers and policy-makers. It proposes a scientific definition of 'effectiveness of PAs' and a formula to estimate this parameter simply and comparatively. According to the Effectiveness Index formula, management is the main factor determining the effectiveness of a PA, as suggested by Hockings et al. (2006), whereas planning, and social perception and valuation are the less determinant factors. These results are only partially consistent with other study which has shown that social support is the main factor determining the condition of a PA and its resources (Leverington et al., 2010).

The SIAPA proposes a framework for the horizontal evaluation of individual PAs on common parameters of use for PA managers, conservationists and scientists. It makes it also possible to compare results among different PAs from similar contexts for the use of PA network managers and decision-makers. Comparing PAs on

Table 4
Indicators included in both models of the SIAPA, category, type and standardized weighting factor given to each indicator by the experts.

Indicator	Category	Type	Weighting factor
Evolution of populations of endangered species or subspecies[a]	State of conservation	State	2
Existence of updated planning documents[a]	Management	Response	2
Existence of updated management documents[a]	Management	Response	2
Land ownership[a]	Social and economic context	State	2
Area affected by fires[a]	Threats to conservation	Pressure	2
Number of visitors[a]	Threats to conservation	Pressure	2
Zoning[a]	Planning	Response	1.5
Degree of fulfillment of management objectives[a]	Management	Response	1.5
Evolution of investment in the protected area[a]	Management	Response	1.5
Monitoring activities[a]	Management	Response	1.5
Main economic activities in the protected area[a]	Social and economic context	Pressure	1.5
Land use changes[a]	Social and economic context	Pressure	1.5
Perception of the conservation state[a]	Social perception and valuation	State	1.5
Economic valuation of the protected area[a]	Social perception and valuation	State	1.5
Presence of alien invasive species[a]	Threats to conservation	Pressure	1.5
Fragmentation[a]	Threats to conservation	Pressure	1.5
Local population density[a]	Threats to conservation	Pressure	1.5
Health of vegetation[a]	State of conservation	State	1
Surface water quality[a]	State of conservation	State	1
Air quality[a]	State of conservation	State	1
Presence of solid waste[a]	State of conservation	State	1
Landscape impact	State of conservation	State	1
Appropriateness of protection legislation[a]	Planning	Response	1
Existence of updated documents on social and economic development	Planning	Response	1
Existence of updated documents on public use	Planning	Response	1
Evolution of the area designated as protected	Planning	Response	1
Degree of characterization of the protected area[a]	Management	Response	1
Evolution of feature(s) for which the protected area was designated[a]	Management	State	1
Existence of sufficient management staff[a]	Management	Response	1
Sanctioning procedures	Management	Response	1
Effectiveness of public participation bodies	Management	Response	1
Easiness to identify the protected area	Management	Response	1
Public use infrastructure	Management	Response	1
Existence of environmental education and volunteering activities	Management	Response	1
Production and distribution of an annual report on activities and outcomes	Management	Response	1
Number of municipalities in the protected area[a]	Social and economic context	Pressure	1
Area provided for the protected area by municipalities under local Agenda 21	Social and economic context	Response	1
Degree of knowledge on the protected area	Social perception and valuation	State	1
Personal importance	Social perception and valuation	State	1
Accessibility[a]	Threats to conservation	Pressure	1
Climate change[a]	Threats to conservation	Pressure	1
Isolation	Threats to conservation	Pressure	1
Activities performed by visitors	Threats to conservation	Pressure	1
Total = 43 (28[a])			

[a] Indicators included in the simplified model.

objective, simple and meaningful bases over time is increasingly demanded (Parrish et al., 2003). However, few such systems have been developed so far. This intermediate PA assessment level complements other levels of evaluation above and below it: PA network assessments and site-specific, goal-oriented assessments.

Regarding the selection of effectiveness categories, we assumed that any PA that is in a good conservation state, has adequate planning, is well managed, has a good socioeconomic context, is positively perceived and valuated by local populations, and has little or no threats will have more chances to conserve its resources in the long-term than other with opposing values.

The SIAPA has been designed to be flexible and adaptable. The development of two models allows adaptation to the circumstances of assessments in term of time and resources needed. Of the two models of the SIAPA developed and tested, the CM should be used when the aim of the assessment is to maximize the amount of information on PAs whereas the SM should be used if the aim is to enhance cost-effectiveness. Once one model is chosen, it should be used consistently, as aggregated results are not directly comparable.

The integration of indicators into indexes and of indexes into a single super-index makes the SIAPA a complete, modular and hierarchical system, from which any result of interest can be extracted at any assessment level: variable, indicator, index or super-index. The integrative nature of the SIAPA allows the assessment of only parts of the complete system (the state of conservation, for instance), individually or comparatively.

The grouping of indicators into clearly defined categories allows precise differentiation between 'management effectiveness' (the MAI) and the evaluation of other parameters, avoiding most limitations of the current PAME concept proposed by Hockings et al. (2000, 2006).

The use of aggregated indexes to convey complex information simply has been pointed out by different studies: Bertzky and Stoll-Kleemann (2009), Fraser et al.

(2006), Martínez-Vega et al. (2009) and Paleczny and Russell (2005), although they are also considered to oversimplify reality (Spangenberg, 2002). Aggregated results (partial indexes and EI_) should, however, be compared with caution, as different types and numbers of indicators might have been selected for calculating the indexes for different PAs. As a result, whereas indicators' values can be compared directly provided rough data periods are the same, aggregated comparisons among PAs should be interpreted and used more as management guidance than as scientific evidence.

The establishment of reference values for every variable, indicator and index is a clear step forward for sustainability science. The proposed thresholds represent a reference to where we aim to be in terms of sustainability (Moldan et al., 2012; Spangenberg, 2011) and define acceptable ranges of variation (Parrish et al., 2003). They allow making conservation decisions even if current evidence remains incomplete (Pullin, 2002; Spangenberg, 2011). When establishing thresholds or cutoffs we always considered the irreplaceable character of many of the features protected by PAs. Therefore, in absent of references we established exigent thresh-olds based on the precautionary principle (Cooney and Dickson, 2005) instead of more standard ones such as quartiles. That is why lower cutoffs are usually wider than upper ones. However, further research is needed to ensure the ecological basis of selected thresholds, variables, indicators, indexes and their relationships, according to the biophysical properties of the system (Moldan et al., 2012). Ecological models can notably help achieving this target (Parrish et al., 2003).

The SIAPA was developed in a participatory way, with 12 institutions contacted to provide input. Eight of these provided some form of collaboration, with remarkable input from six of them, including the managers of the PAs of the Autonomous Region of Madrid (CMAOT) as potential main users of the system. Although participation was limited because it was voluntary (Spangenberg, 2011), it can be considered to be adequately representative in comparison with most assessment systems worldwide (Chape et al., 2008).

Even though numerous experts gave their views on different parts of the SIAPA, it is a pilot system, which can and should be improved. Some indicators might have to be included in and/or excluded from both models as a result of new knowledge, as indicator selection is one of the most sensitive steps in environmental assessments (Moldan et al., 2012). Thresholds should be redefined for some variables in the light of new evidence or normative changes (Rametsteinera et al., 2011). Some of the indicators or indexes might have to be recalculated or weighted differently to perfect the system (Pomeroy et al., 2005) or to adapt it to other contexts.

Although it was conceived with a wide scope, the SIAPA was developed within particular temporal (2009), social (European) and bio-geographical (Mediterranean) contexts. It analyses the parameters considered to be more important within these contexts. Therefore, adaptations should be considered when replicating this system. The proposed indicators, thresholds and weighting factors might need to be adapted to the biophysical, geographical, legal and socioeconomic contexts of the places where it will be implemented to be fully meaningful. Conducting ad hoc surveys among local experts previous to the implementation of the system in different contexts should help redefining these aspects.

Finally, the development and inclusion of complementary marine and coastal indicators in the SIAPA would make it useable for assessing most types of PAs.

5. Conclusion

The SIAPA is a promising new tool for assessing the effectiveness of PAs in an integrated manner. The overall characteristics of the SIAPA (namely its focus and its integrated, modular, hierarchical, numerical and comparative structure) make it different from other PA assessment systems. It accomplishes most of the desired characteristics of sustainability science (Spangenberg, 2011): it is purpose-bound, it provides an integrated assessment, and it was developed in an interdisciplinary way, getting input from sciences (social and natural) as well as from empirical experience.

The current environmental crisis calls for immediate action to attain more sustainable ways of human development. The SIAPA has been developed to become one of such actions

Acknowledgements

The authors would like to thank all those who contributed to this paper. We would like to acknowledge the expert panel and all the people in the various institutions and administrations who provided data and advice on conducting the assessment, especially the staff of the Ministry of Environment of the Autonomous Region of Madrid. We would also like to thank David Riaño Arribas, Spanish National Research Council, Alain Jeudy de Grissac, IUCN Centre for Mediterranean Cooperation, Elizabeth Heseltine and the anonymous reviewers for their useful remarks on the different drafts of this paper. This study was funded by a JAE doctoral grant from the Spanish National Research Council.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ecolind.2012.05.009.

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Indicators used in the SIAPA

I. State of conservation: six indicators

1.1. Evolution of populations of endangered species or subspecies	
Category	State of conservation
Type	State
Description	This indicator assesses the evolution in numbers of the populations of endangered species or subspecies dwelling within the protected area with a category of threat established in an official or scientific register as (EN) or (CR)
Rationale	The main purpose of protected areas is nature conservation (Múgica *et al*. 2009), especially of threatened biodiversity at the genetic, specific and ecosystem levels. The dynamics of threatened species populations must be monitored in particular, because of their fragility (Atauri *et al*., 2002). Although the existence of species or subspecies registered as (EN) or (CR) in a protected area indicates a good conservation state, the temporal evolution of their populations is crucial, as it is related to management effectiveness. This parameter is therefore usually used to assess the effectiveness of a protected area (Pomeroy *et al*., 2005). It is also one of the criteria used to assess the favourable conservation state of the species included in the annexes of the Habitats Directive (Walder *et al*., 2006). An increase or stabilization of those populations implies an adequate conservation state, whereas a decrease in the number of individuals of those species or subspecies indicates degradation of the characteristics of the protected area. Thus, both tendencies suggest a response of biodiversity to the conservation state of the area
Data source	Official register
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The analysis period will be as long as possible; if possible, since the date of designation of the protected area. At a minimum, data for 3 years, not spaced over 2 years (at regular annual or 2-yearly intervals), up to the most recent date will be considered. The most recent date must not be earlier than 2 years before the assessment year. The assessment period will be split into three equal intervals. The temporal evolution of the endangered populations will be considered: • *Positive*: if their populations counted by census or estimated by sampling, maintain an increasing trend in numbers: > 5% between the initial and the intermediate year and between the intermediate and the final year. A score of 2 points will be given. • *Stable*: if their populations counted by census or estimated by sampling, do not vary notably: ± 5% of the average population size between the two periods or they are < 5% in the intermediate year but > 5% in the final year in relation to the initial year. A score of 1 point will be given.

	• *Negative*: if their populations counted by census or estimated by sampling, maintain a decreasing trend: < 5% between the initial and the intermediate year and between the intermediate and the final year. A score of 0 points will be given. The total value of the indicator (X) for each protected area will be the average score for each of the values for each species or subspecies that thrive in that protected area: • $X \geq 1.5 \rightarrow 2$ points • $1.5 > X \geq 1 \rightarrow 1$ point • $X < 1 \rightarrow 0$ points *Explanatory notes* When there are different (EN) or (CR) species or subspecies in the protected area, the results will be shown individually for each in a table. Then, scores for each species or subspecies will be added and divided by the number of species or subspecies. Because of the importance of this parameter for biodiversity conservation, when any of the species or subspecies scores 0, the value of X will always be 0 points, if at the same time there are not two or more species or subspecies with positive trends (with updated data ≤ 2 years old). In this case, X will be 1 point. In any case, lack of data on any (EN) or (CR) species or subspecies, outdated data (> 2 years old) or a negative trend for two or more species or subspecies in the same protected area will entail an X of 0 points. 'Presence/absence' data are not scored. Therefore, they will be considered 'Not applicable' and valued 0 points.
Tendency	The tendency of the indicator will be *positive* if all the (EN) or (CR) species or subspecies populations increase in numbers, whatever the magnitude of the increase. The tendency of the indicator will be *positive* if the number of individuals of (EN) or (CR) species or subspecies oscillates within ± 5% in the three measurement years. The tendency of the indicator will be *negative* if all the (EN) or (CR) species or subspecies populations decrease in numbers between the two analysed periods, whatever the magnitude of this decrease. The tendency will be considered 'Not applicable' if different (EN) or (CR) species or subspecies populations have opposite trends or if data are presented as 'presence/absence'.
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 47, 53.3, 53.4, 55.1, 55.3, 56.1 y 56.2. • Ley 2/1991, de 14 de febrero, para la Protección de la Fauna y la Flora Silvestres en la Comunidad de Madrid. Arts. 6 y 7. • Real Decreto 439/1990, de 30 de marzo, por el que se regula el Catálogo Nacional de Especies Amenazadas. Arts. 3, 6.2 y 7.2. Actualizaciones. • Decreto 18/1992, de 26 de marzo, por el que se aprueba el Catálogo Regional de Especies Amenazadas de Fauna y Flora Silvestres y se crea la Category de árboles singulares. Arts. 2.1, 5 y Anexo único (excepto 2.E). • Atauri, J.A.; de Lucio. J.V. y Castell, C. 2002. *El papel de los indicadores en la gestión de los espacios naturales protegidos*. En Ramírez, L. (Coord.). *Indicadores ambientales. Situación actual y perspectivas*. Organismo Autónomo Parques Nacionales. Madrid.

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1.2. Health of vegetation	
Category	State of conservation
Type	State
Description	This indicator assesses the changes in the defoliation and decoloration of trees. These changes may be due to air pollution, fires, human activities, plant diseases or adverse soil or weather conditions
Rationale	The health of vegetation is seen in parameters such as decoloration, defoliation or deterioration. In the Mediterranean area, defoliation is considered to be an accurate indicator of 'forest damage' (VVAA, 1996). Defoliation thresholds are established by agreement (EU, UNECE), as no physiological thresholds have been defined yet (Lorenz *et al*., 2007)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The following parameters will be measured for the last year for which data are available. They will be considered and valuated as follows: • Defoliation (X) Null: if $X \leq 10\% \rightarrow 2$ points Moderate: if $10\% < X \leq 25\% \rightarrow 1$ point High: if $X > 25\% \rightarrow 0$ points • Decoloration (Y) Null: if $Y \leq 10\% \rightarrow 2$ points Moderate: if $10\% < Y \leq 25\% \rightarrow 1$ point High: if $Y > 25\% \rightarrow 0$ points If there are different plots within a protected area, a simple average of the scores for the two parameters will be used for the year considered. The **health of vegetation** will be the average of the two parameters (Z). It will be considered and valuated as follows:

	• **Adequate**: if Z > 1.5 → 2 points • **Moderate**: if 1.5 ≤ Z ≤ 1 → 1 point • **Deficient**: if Z < 1 → 0 points
Tendency	The tendency will be measured by subtracting the average defoliation and decoloration values (in percentages) for the last 2 years assessed (H) from the average values for the two parameters (also in percentages) for the 5 years previous to the last 2 years (K). The tendency will be *positive* if H < K , *stable* if H = K, and *negative* if H > K.
References	• VVAA. 1996. *Sistema español de indicadores ambientales: subáreas de biodiversidad y bosque*. Ministerio de Medio Ambiente. Madrid. • Lorenz, M.; Fischer, R.; Becher, G.; Granke, O.; Roskams, P.; Nagel, H.D.; and Kraft, P. 2007. *Forest Condition in Europe. 2007 Technical Report of ICP Forests*. Federal Research Centre for Forestry and Forest Products & Department of Wood Science, University of Hamburg. Hamburg. • International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests. En: http://www.icp-forests.org/

1.3. Surface water quality	
Category	State of conservation
Type	State
Description	This indicator assesses the state and evolution of different parameters affecting the quality of surface waters (water masses or water courses), which may also influence living organisms
Rationale	Surface waters are the living environment for many organisms. They are also a vital need for all of them. Surface waters are present in numerous ecosystems and protected areas. Many organisms and ecosystems (some of which are endangered) depend on adequate water quality. As a result, evaluating the quality of surface waters is relevant to determining the state of conservation of protected areas (Pomeroy *et al*., 2005; Mallarach *et al*., 2008; VVAA, 2008)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The annual average values of the following parameters will be measured from a minimum of two non-consecutive quarterly values, in surface water masses and courses, since the designation date of the protected area or the first available data, up to the last available annual value. They will be valuated as follows: 1. Dissolved oxygen (DO): - If [DO] > 5 mg/l: 1 point - If [DO] ≤ 5 mg/l: 0 points 2. 5-year biochemical oxygen demand (BOD_5): - If BOD_5 < 6 mg/l: 1 point - If BOD_5 ≥ 6 mg/l: 0 points 3. pH: - If pH: 6 < pH < 9: 1 point

	- If pH ≤ 6 or pH ≥ 9: 0 points 4. Temperature (T) water[1]: - If T ≤ 19 ºc: 1 point - If T > 19 ºc: 0 points 5. Total phosphorus (tP): - If tP < 0.4 mg/l: 1 point - If tP ≥ 0.4 mg/l: 0 points 6. Nitrate: - If $[NO_3]$ < 25 mg/l: 1 point - If $[NO_3]$ ≥ 25 mg/l: 0 points 7. Nitrite: - If $[NO_2]$ < 0.3 mg/l: 1 point - If $[NO_2]$ ≥ 0.3 mg/l: 0 points 8. Amonium: - If $[NH_4]$ < 1 mg/l: 1 point - If $[NH_4]$ ≥ 1 mg/l: 0 points The quality of each water mass or water course (C) will result from the addition of the results for the eight parameters applicable (X) for the last year for which data are available. Thus, its quality will be considered: • C Adequate: if X = 8 points • C Moderate: if X = 7 points • C Deficient: if X ≤ 6 points The quality of the set of surface waters (Qw) in the protected area will be calculated as the average value of the scores for the water masses or water courses considered within the protected area (Y). It will be considered and valuated as follows: • Qw **Adequate**: if Y ≥ 7.5 points → 2 points • Qw **Moderate**: if 7.5 > Y > 6 points → 1 point • Qw **Deficient**: if Y ≤ 6 points → 0 points *Explanatory note* The parameters for water quality and their thresholds were selected according to the legally established values in "Orden ARM/2656/2008, de 10 de septiembre, por la que se aprueba la instrucción de planificación hidrológica, Tables 10, 11, 12 and 14".
Tendency	The tendency will be measured by comparing the Qw value for the last year analysed with the Qw value for the previous year analysed. Whenever possible, the comparison will be made with the year inmediately before the last year analysed.
References	• Directiva 2000/60/CE del Parlamento Europeo y del Consejo, de 23 de octubre de 2000, por la que se establece un marco comunitario de actuación en el ámbito de la política de aguas. Arts. 1.a, 2, 4.1.a, 4.2, 8.1 y Anexo V. • Real Decreto 927/1988, de 29 de julio, por el que se aprueba el Reglamento de la Administración Pública del Agua y de la Planificación Hidrológica, en desarrollo de los Títulos II y III de la Ley

[1] Reference value calculated from the application of a +10% to the highest value of the analysed data set from surface waters in the Autonomous Region of Madrid (17.5 ºc).

	de Aguas. Anexo 3. • Real Decreto 1664/1998, de 24 de julio, por el que se aprueban los Planes Hidrológicos de Cuenca. Art. 1. • Ley 7/1990, de 28 de junio, de Protección de embalses y Zonas húmedas de la Comunidad Autónoma de Madrid. Arts. 5.2.c, 8, 14.b,c,d y 16. • Plan Hidrológico de la Cuenca del Tajo. En: http://www.chtajo.es/pdf_tajo/normativa/plan_hidrologico.pdf • Orden ARM/2656/2008, de 10 de septiembre, por la que se aprueba la instrucción de planificación hidrológica. • García Vila, F. (Coord.). 1993. *Variables ambientales del espacio natural «Regajal – Mar de Ontígola»*. Centro de Estudios y Experimentación de Obras Públicas, Gabinete de Formación y Documentación. Madrid. • Álvarez-Cobelas, M.; Riolobos, P.; Himi, Y.; Sánchez-Carrillo, S.; García-Avilés, J. e Hidalgo, J. 2000. *Estudio físico-químico de los ambientes estancados del Parque Regional del Sureste de la Comunidad de Madrid*. Serie Documentos nº 29. Centro de Investigaciones Ambientales de la Comunidad de Madrid "Fernando González Bernáldez". • Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • VVAA. 2008. Primer Informe de Situación de la Red de Parques Nacionales a 1 de enero de 2007. Organismo Autónomo Parques Nacionales. Ministerio de Medio Ambiente. En: http://reddeparquesnacionales.mma.es/parques/org_auto/informacion_general/red_informe.htm

1.4. Air quality	
Category	State of conservation
Type	State
Description	This indicator assesses the state and evolution of the immission levels of different air pollutants affecting living organisms
Rationale	High concentrations of air pollutants in the lower atmosphere can have negative impacts on living organisms (mainly vegetation), materials and human health (UN, 2007). It is therefore highly advisable to monitor basic determinants of adequate air quality continuously in particularly sensitive areas,such as protected areas
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	Limit or target values for the protection of vegetation and/or ecosystems will be measured according to current legislation for the parameters SO_2, NO_x and O_3, or those available among these ones, depending on the air control station. Limit values per pollutant substance: • SO_2: 20 µg/m^3 civil year plus winter (no tolerance)

	• NO_x: 30 µg/m^3 civil year plus winter (no tolerance) • O_3 (AOT40): 18 000 µg/m^3 ·h as a 3- or 5-year average Average annual values for the three parameters will be chosen for the available air control stations for the last year for which data are available. Their values will be interpolated on a GIS raster map of the area using the 'Spline Tension' method. Then, the average concentration of each parameter in each protected area will be calculated. Each parameter will be valuated from 0 to 2 points as follows: • NO_x: -If the annual average value is > 30 µg/m^3, the value will be 0 points. -If the annual average value is 20–30 µg/m^3, the value will be 1 point.. -If the annual average value is < 20 µg/m^3, the value will be 2 points. • SO_2: -If the annual average value is > 20 µg/m^3, the value will be 0 points. -If the annual average value is 10^1–20 µg/m^3, the value will be 1 point. -If the annual average value is < 10 µg/m^3, the value will be 2 points. • O_3: -If the annual average value is over 18 000 (µg/m^3)h, the value of the parameter will be 0 points. -If the annual average value is 6,000–18 000 (µg/m^3)h, the value will be 1 point. -If the annual average value is < 6,000 (µg/m^3)h, the value will be 2 points. The total value of the indicator will be calculated by adding the values for the three parameters (X). Thus, the **air quality** of the protected area will be considered and valuated as follows: • Adequate: if X ≥ 5 points → 2 points • Moderate: if X = 4 points → 1 point • Deficient: if X ≤ 3 points → 0 points If there are values for only two of the parameters (Y), the **air quality** will be considered and valuated as follows: • **Adequate**: if Y = 4 points → 2 points • **Moderate**: if Y = 3 points → 1 point • **Deficient**: if Y < 3 points → 0 points *Explanatory note* [1] Damage to living organisms (lichens) starts at 10 µg/m^3 (de Smet *et al*., 2007).
Tendency	The tendency will be measured by comparing the values for the three variables for the last year analysed and the previous year for which data are available, ideally the year immediately before the last year analysed. If the value of each variable in the last year is larger than their value in the previous year, 1 point will be subtracted. If the value is smaller than the previous value, 1 point will be added. If the value is the same, 0

	points will be added. The tendency between the two years analysed will be obtained by the simple addition of the results for the three variables, with possible values from +3 (maximum positive tendency) to –3 (maximum negative tendency). 0 indicates a stable tendency and may be due to equal values for the variables or to addition of positive and negative values of the variables.
References	• Ley 34/2007, de 15 de noviembre, de calidad del aire y protección de la atmósfera. Arts. 1, 8.1, 8.2, 8.3, 10, 18.1 y 19. • Real Decreto 1073/2002, de 18 de octubre, sobre evaluación y gestión de la calidad del aire ambiente en relación con el dióxido de azufre, dióxido de nitrógeno, óxidos de nitrógeno, partículas, plomo, benceno y monóxido de carbono. Arts. 2, 4.1, 5.1 y 8.1. • Real Decreto 1796/2003, de 26 de diciembre, relativo al ozono en el aire ambiente. Arts. 1, 2 y 3.1. • De Smet, L.; Devoldere, K.; and Vermoote, S. 2007. *Valuation of air pollution ecosystem damage, acid rain, ozone, nitrogen and biodiversity. Final report.* DG ENV. European Commission. En: http://ec.europa.eu/environment/air/pollutants/valuation/pdf/synthesis_report_final.pdf • EEA. 2007. *Air pollution in Europe 1990-2004*. EEA Report 2/2007. European Environment Agency. Office for Official Publications of the European Communities. Luxembourg. • UN. 2007. *Environmental Indicators and Indicator-Based Assessments Reports*. Eastern Europe, Caucasus and Central Asia. United Nations. New York and Geneva. • EIONET Central Data Repository. En: http://cdr.eionet.europa.eu/es/eu/annualair/envssmwaw/questionnaire_year_2008_Directive_461_2004_es_V0.xls/manage_document • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

1.5. Presence of solid waste	
Category	State of conservation
Type	Pressure
Description	This indicator assesses the presence of conspicuous and toxic solid waste as well as rubbish dumps in protected areas
Rationale	The presence of scatered or concentrated solid waste has a notable impact on the landscape quality of a protected area. Moreover, solid waste may become a relevant source of pollution for living organisms, depending on their characteristics and the environment where they are disposed (Buckley *et al*., 2003; Brown *et al*., 2010)
Data source	Censuses; CORINE Land-Cover
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	A census will be conducted of dispersed solid waste on the main 'vulnerable zones' of the protected area (picnic areas). All the picnic areas of the protected area will be visited early in the morning, from

	Monday to Friday, in a consecutive, non-repeated manner, during the month with the highest visitor influx to the protected area. In protected areas with no picnic areas inside, the total area of solid waste found on a 1000-m linear transect along the paths starting at the main entrance(s) to the protected area will be counted. The area covered by solid waste will be counted on the width of all paths plus a lateral 1-m band on each side of the path. An average width for each path will be estimated together with its total length (to a maximum of 1000 m), to obtain the total censused area. Two transects for each path will be measured on different non-consecutive weekdays, with at least 1 week between them, and also during the month with the highest visitor influx to the protected area. The method thus reflects the worst possible temporal state of the indicator. The area covered by dispersed solid waste (X) will be considered and valuated as follows: • Null or low presence: if $X \leq 3$ m^2/ha) → 2 points • Moderate presence: if $3 < X \leq 10$ m^2/ha → 1.5 points • High presence: if $X > 10$ m^2/ha → 0 points If toxic or hazardous waste (Y) were found, the following values will be subtracted from the previous ones, depending on the percentage of toxic or hazardous waste found related to the total quantity of dispersed solid waste (Y): • If $Y < 1\%$ → 0 points • If $1 \leq Y < 5\%$ → 0.2 points • If $Y \geq 5\%$ → 0.5 points Additionally, the percentage of the total area of the protected area covered by rubbish or rubble dumps (Z) will also be considered using GIS. The following values will be subtracted from the previous one as follows: • If $Z < 1\%$ → 0 points • If $1 \leq Z < 5\%$ → 0.5 points • If $Z \geq 5\%$ → 1 point Thus, the **presence of solid waste** in the protected area (W) will be the result of subtracting the three previous values: W = X-Y-Z. It will be considered and valuated as follows: • **Low**: $W = 2$ → 2 points • **Moderate**: $2 > W \geq 1.5$ → 1 point • **High**: $W < 1.5$ → 0 points *Explanatory note* The minimum indicator value is 0. Negative values are not considered.
Tendency	The tendency will be measured by comparing the scores for the three variables between the last year analysed and the previous available data. If the score of each of the three variables for the last year analysed is larger than their scores for the year of comparison, 1 point will be subtracted; if their scores are smaller that those of the year of comparison, 1 point will be added; if their scores are the same for the two years, 0 points will be added. Thus, the tendency between the two

	years analysed will be obtained by simple addition of the scores for the three variables, with possible values ranging from +3 (maximum positive tendency) to –3 (maximum negative tendency). 0 indicates a stable tendency and may be due to equal scores for the variables or to the addition of positive and negative values for the variables.
References	• Ley 10/1998, de 21 de abril, de Residuos. Arts. 2, 3, 4.2, 34.2.a.b.c, 34.3.a.b. • Real Decreto 952/1997, de 20 de junio, por el que se modifica el Reglamento para la ejecución de la Ley 20/1986, de 14 de mayo, básica de residuos tóxicos y peligrosos, aprobado mediante Real Decreto 833/1988, de 20 de julio. Anexo 2. • Gómez-Limón, J.; Múgica, M.; Medina, L.; y De Lucio, J.V. 1994. *Áreas recreativas en la Comunidad de Madrid. Afluencia de visitantes y actividades desarrolladas*. Serie Documentos, nº 14. Centro de Investigación "Fernando González Bernáldez". Soto del Real, Madrid. • Buckley, R.; Weaver, D.B.; and Pickering, C. (Eds). 2003. *Nature-based tourism, environment and land management*. Oxfordshire, UK, and Cambridge, USA. CABI Publishing. • Brown, T.J.; Ham, S.H.; and Hughes, M. 2010. *Picking up litter: an application of theory-based communication to influence tourist behaviour in protected areas. Journal* of Sustainable Tourism 18 (7): 879-900. • Rodríguez-Rodríguez, D. In press. Littering in protected areas: a conservation and Management challenge. A case study from the Autonomous Region of Madrid. Journal of Sustainable Tourism. DOI: 10.1080/09669582.2011.651221

1.6. Landscape impact	
Category	State of conservation
Type	State
Description	This indicator assesses the impacts on the landscape in protected areas in an aggregated manner
Rationale	Despite the relevance of landscapes as aesthetic, cultural, ecological and recreational resources, they are not usually considered in assessments of protected areas or on the status of the environment or sustainability. Human activities, such as the growth of urban areas, the building of infrastructure or the installation of waste dumps, change the characteristics of the landscapes (Aramburu *et al*., 2003). In order to compare the visual quality of a landscape independently of its intrinsic quality, only the quantity and severity of the impacts on the landscapes in each protected area were considered. Therefore, the best-conserved landscape is that with the fewest impacts on its visual quality
Data source	
Data availability	
Updating	Every 4 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The viewsheds of the main elements that have negative impacts on landscapes in the territory comprising each protected area will be calculated using GIS. Landscape impact scores will be obtained by simple addition of the

	scores for each raster output layer, each pixel scoring 0 (not visible) or 1 (visible). Then, the average landscape impact score will be calculated for each protected area (X) by weighting each impacting element as follows: -Highway network (x3) -Main road network (x2) -Secondary road network (x1) -Local road network (x1) -Railway network (x1) -Rubbish and rubble dumps (x3) -Urban areas (x2) The **landscape impact** in the protected area (X) will be considered and valuated as follows: • **Low**: if $0 \leq X \leq 4 \rightarrow 2$ points • **Moderate**: if $4 < X \leq 7 \rightarrow 1$ point • **High**: if $X > 7 \rightarrow 0$ points
Tendency	The tendency will be considered *positive* if X is larger than in the preceding assessment, *stable* if it is the same, or *negative* if it is smaller
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 2, 3.26, 19.b, 30.1, 34 y 46. • Ley 16/1995, de 4 de mayo, Forestal y de Protección de la Naturaleza. Art. 2.1.c. • Aramburu, M. P.; Escribano, R.; Ramos, L.; y Rubio, R. 2003. *Cartografía del Paisaje de la Comunidad de Madrid*. Consejería de Medio Ambiente. Comunidad de Madrid. Madrid.

II. Planning: seven indicators

2.1. Appropriateness of protection legislation	
Category	Planning
Type	Response
Description	This indicator assesses the adequacy of the protection legislation affecting the protected area and, particularly, the designation norm and the protection category
Rationale	Most protected areas are established though legal processes (Chape *et al*., 2008). The existence of an adequate legal framework is considered the first step in efficient management of a protected area (Pomeroy *et al*., 2005). It is also one of the minimum standard requirements for individual protected areas (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Every 4 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The following issues in the legal regime governing the protected area will be valuated:

	• The protected area was designated after enactment of a law on protected areas containing modern conservation principles* (X). Yes: 1 point; No: 0 points. • The protection category is adequate for the conservation objectives of the protected area that were established in its designation norm** (Y). Yes: 1 points; Partially: 0.5 points; No: 0 points. The **appropriateness of the protection legislation** for the protected area (Z) will be derived by adding the scores for the two parameters (Z = X+Y). It will be considered and valuated as follows: • **Adequate**: if Z = 2 → 2 points. • **Moderate**: if 1 ≤ Z < 2 → 1 point. • **Deficient**: if Z < 1→ 0 points. *Explanatory note* *If the designation norm of the protected area already includes modern conservation principles (e.g. wider countryside, buffer or connectivity issues), it will be valuated 1 point. **If the designation norm has no defined conservation objectives, it will be valuated 0 points.
Tendency	The tendency will be *positive* if X increases between the two analysed periods, *stable* if it remains the same, and *negative* if it decreases.
References	• Ley 4/1989, de 27 de marzo, de Conservación de los Espacios Naturales y de la Fauna y Flora Silvestres. Título III. • Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Capítulos II y III. • Ley 23 de ENERO 1985, NUM 1./1985. Parque Regional de la Cuenca Alta del Manzanares. • Ley 23 de ABRIL 1987, NUM. 2/1987. Amplía el Parque Regional de la Cuenca Alta del Manzanares. • Ley 20 de ABRIL 1988, NUM. 2/1988. Modifica determinados preceptos de la Ley 23 enero 1985, de creación del Parque Regional de la Cuenca Alta del Manzanares. • Ley 7 de FEBRERO 1991, NUM. 1/1991. Modifica la Ley 23 enero 1985 (R. 1985/289), de creación del Parque Regional de la Cuenca Alta del Manzanares. • Ley 4 ABRIL 1991, NUM. 7/1991. Ampliación del Parque Regional de la Cuenca Alta del Manzanares. • Ley 21 ABRIL 1993, NUM. 5/1993. Modifica Ley 4 abril 1991 (LCM 1991, 71), de ampliación del Parque Regional de la Cuenca Alta del Manzanares. • Ley 10/2003, de 26 de marzo, de modificación de la Ley del Parque Regional de la Cuenca Alta del Manzanares y de la Junta Rectora del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Ley 20/1999, de 3 de mayo, del Parque Regional del Curso Medio del río Guadarrama y su entorno. • Ley 4/2001, de 28 de junio, por la que se modifica la Ley 20/1999, de 3 de mayo, del Parque Regional del Curso Medio del río Guadarrama y su entorno. • Ley 6/1994, de 28 de junio, sobre el Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. • Ley 7/2003, de 20 de marzo, de modificación de la Ley 6/1994, de 28 de junio, de Creación del Parque Regional en torno a los ejes de los

	cursos bajos de los ríos Manzanares y Jarama. • Decreto 14 FEBRERO 1991, NUM. 5/1991. Declara refugio de fauna a la Laguna de San Juan y su entorno. • Decreto 30 de JUNIO 1994, NUM. 68/1994. Declara Reserva Natural "El Regajal-Mar de Ontígola", en Aranjuez y aprueba su Plan de Ordenación de los Recursos Naturales. • Decreto 30 AGOSTO, NUM. 2868/1974. Declaración de sitio natural de interés nacional "El Hayedo de Montejo de la Sierra". • Decreto 169/2000, de 13 de julio, por el que se establece para el espacio natural "Soto del Henares", en los términos municipales de Alcalá de Henares y Los Santos de la Humosa, un régimen de protección preventiva. • Ley 10 MAYO 1990, NUM. 6/1990. Declaración del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Decreto 16 NOVIEMBRE, NUM. 2418/1961. Declaración de Paraje Pintoresco el Pinar de Abantos y Zona de la Herrería del Real Sitio de San Lorenzo de El Escorial. • Real Orden núm. 213, de 30 de septiembre de 1930, del Ministerio de Fomento, de Parques y Reservas Naturales (Gaceta de Madrid, 12/10/1930). • De Lucio, J. V.; Ramírez, L.; Sastre, P.; Martínez, R.; Cuevas, J. A.; Alcaide, X; y Hernández-Guillén, D. 1997. *Metodología de evaluación multiobjetivo/multicriterio para el apoyo a la toma de decisiones en la selección de zonas especiales de conservación (Natura 2000. Unión Europea) en la Comunidad de Madrid*. Serie Documentos, nº 25. Centro de Investigaciones Ambientales de la Comunidad de Madrid Fernando González Bernáldez. Soto del Real. Madrid. 46 pp. • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. *How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas*. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

2.2. Existence of updated planning documents	
Category	Planning
Type	Response
Description	This indicator assesses the existence of updated planning documents describing the natural resources of the protected area and regulating their use
Rationale	No organization can achieve its management objectives without appropriate planning at different levels (Chape *et al*., 2008). Documents

	addressing the planning of natural resources are fundamental normative tools for adequate planning of protected areas and their surrounding territories (Múgica *et al*., 2010)
Data source	
Data availability	
Updating	Every 2 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **existence of updated planning documents** will be considered and valuated as follows: • **Adequate**: if there are updated* natural resources planning documents in force for the protected area → 2 points. • **Moderate**: if there are natural resources planning documents for the protected area, but they are not updated or not in force → 1 point. • **Deficient**: if there are no natural resources planning documents for the protected area → 0 points. *Explanatory notes* *A document is considered "not updated" when it is older than its stipulated enforcement period or, if that period is not specified, the document or plan is over 10 years old.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if the value is the same in the two assessments, and *negative* if the most recent value is lower than the previous one
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 15.1, 23 y 35. • Ley 6/1994, de 28 de junio, sobre el Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. Art. 10. • Ley 10 MAYO 1990, NUM. 6/1990. Declaración del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara. Disp. Transitoria segunda. • Decreto 26/1999, de 11 de febrero, por el que se aprueba el Plan de Ordenación de los Recursos Naturales para el Curso Medio del Río Guadarrama y su entorno. • Decreto 124/2002, de 5 de julio, por el que se aprueba la ampliación del Plan de Ordenación de los Recursos Naturales del Parque Regional del Curso Medio del río Guadarrama y su entorno. • Decreto 27/1999, de 11 de febrero, por el que se aprueba el Plan de Ordenación de los Recursos Naturales del Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. • Decreto 30 de JUNIO 1994, NUM. 68/1994. Declara Reserva Natural "El Regajal-Mar de Ontígola", en Aranjuez y aprueba su Plan de Ordenación de los Recursos Naturales. • Decreto 143/2002, de 1 de agosto, por el que se aprueba la revisión del Plan de Ordenación de los Recursos Naturales de El Regajal-Mar de Ontígola. • Decreto 178/2002, de 14 de noviembre, por el que se aprueba el Plan de Ordenación de los Recursos Naturales del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara y su Área de Influencia Socioeconómica. • Decreto 169/2000, de 13 de julio, por el que se establece para el espacio natural "Soto del Henares", en los términos municipales de Alcalá de Henares y Los Santos de la Humosa, un régimen de protección preventiva. Art. 4. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the

	UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Múgica, M.; Martínez-Alandi, C.; Gómez-Limón, J.; Puertas, J.; Atauri, J.A.; y De Lucio, J.V.. 2010. *Anuario EUROPARC-España del estado de los espacios naturales protegidos 2009*. Fundación Fernando González Bernáldez. Madrid.

2.3. Existence of updated documents on social and economic development	
Category	Planning
Type	Response
Description	This indicator assesses the existence of updated documents on the social and economic aspects of the protected area, such as a socioeconomic or sustainable development plan
Rationale	The social and economic plans are normative documents derived by participative approaches, which seek to improve the quality of life of residents inside protected areas or in their influence areas by promoting valorization of the protected area and the goods and services it provides to stimulate economic growth and human well-being (Pinilla, 2007)
Data source	
Data availability	
Updating	Every 4 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **existence of updated documents on social and economic development** will be considered and valuated as follows: • **Adequate**: if there are updated* socioeconomic planning documents in force on the protected area → 2 points. • **Moderate**: if there are socioeconomic planning documents on the protected area, but they are not updated or not in force → 1 point. • **Deficient**: if there are not socioeconomic planning documents on the protected area → 0 points. *Explanatory note* *A document is considered "not updated" when it is older than its stipulated enforcement period or, if that period is not specified, the document or plan is over 10 years old. If the plan is included as detailed specifications in another plan, such as a natural resources or management plan, it will be valuated as if it were an independent plan.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if the value is the same in the two assessments, and *negative* if the most recent value is lower than the previous one
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 2, 15 y 38.

	• Pinilla, R. (Coord.). 2007. *Plan de Desarrollo Sostenible. Parque Natural Sierra de Huétor*. Consejería de Medio Ambiente. Junta de Andalucía.

2.4. Existence of updated management documents	
Category	Planning
Type	Response
Description	This indicator assesses the existence of updated documents on the management of the protected area, such as a management plan.
Rationale	Updated, adaptable, information-based management documents are a fundamental requirement for active, effective management of protected areas in the context of global change (Múgica and Gómez-Limón, 2002; Pullin, 2002; de Lucio and Múgica, 2004; Pomeroy *et al*., 2005; Chape *et al*., 2008). The existence of a published, complete, legally approved management plan is one of the minimum international standards for individual protected areas (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Every 4 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **existence of updated management documents** will be considered and valuated as follows: • **Adequate**: if there is an updated* management document in force on the protected area → 2 points. • **Moderate**: if there is a management document on the protected area, which is not updated or not in force → 1 point. • **Deficient**: if there is no management document on the protected area → 0 points. *Explanatory note* *A document is considered "not updated" when it is older than its stipulated enforcement period or, if that period is not specified, the document or plan is over 10 years old. If detailed management criteria are specified in other types of planning documents, these will be considered independent management plans, except for parks, which must have an independent management plan.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if the value is the same in the two assessments, and *negative* if the most recent value is lower than the previous one.
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts.15, 28.1, 30.5 y 45.a. • Ley 23 ENERO 1985, NUM. 1/1985. Parque Regional de la Cuenca Alta del Manzanares. Art. 11. • Ley 20/1999, de 3 de mayo, del Parque Regional del Curso Medio del río Guadarrama y su entorno. Art. 12. • Ley 6/1994, de 28 de junio, sobre el Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. Arts. 16 y 18. • Ley 10 MAYO 1990, NUM. 6/1990. Declaración del Parque Natural

	de la Cumbre, Circo y Lagunas de Peñalara. Art. 6. • Decreto 14 FEBRERO 1991, NUM. 5/1991. Declara refugio de fauna a la Laguna de San Juan y su entorno. Art. 6. • Decreto 9/2009, de 5 de febrero, por el que se aprueba el Plan Rector de Uso y Gestión del Parque Regional en torno a los Ejes de los Cursos Bajos de los Ríos Manzanares y Jarama. • Orden 14 DICIEMBRE 1992. Aprueba el Plan de Gestión del refugio de fauna de la Laguna de San Juan y su entorno. • Acuerdo de 20 de noviembre de 1995, del Consejo de Gobierno, por el que se aprueba la revisión del Plan Rector de Uso y Gestión del Parque Regional de la Cuenca Alta del Manzanares. • Acuerdo de 22 de mayo de 2003, del Consejo de Gobierno, por el que se aprueba definitivamente el Plan Rector de Uso y Gestión del parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Múgica, M. y Gómez-Limón, J. (Coords.). 2002. *Plan de Acción para los espacios naturales protegidos del Estado español*. Fundación fernando González Bernáldez. Madrid. • Pullin, A. 2002. Conservation Biology. Cambridge University Press. Cambridge, UK. • De Lucio, J. V. y Múgica, M. 2004. *Objetivos de gestión e intensidad de la gestión*. En Actas del X Congreso EUROPARC-España. *Alcanzar la eficacia en la gestión de los espacios naturales protegidos*. En: http://www.redeuroparc.org/documentos_anexos/Publicaciones/Actas_ESPARC/actas_esparc04.pdf • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

2.5. Existence of updated documents on public use	
Category	Planning
Type	Response
Description	This indicator assesses the existence of updated documents regulating public use of the protected area, such as plans, programmes or guidelines
Rationale	Recreation activities are currently the main threat to the conservation of European protected areas (Nolte *et al*., 2010) and of the protected areas of the Autonomous Region of Madrid (Rodríguez-Rodríguez, 2008). Such activities are especially serious for protected areas located in densely populated areas. Also, issues related to visitor safety and the quality of visits make adequate regulation of such activities advisable (Ortega *et al*., 2006). In brief, appropriate planning of public use is an

	essential tool for the sustainable management of a protected area (Chape *et al*., 2008)
Data source	
Data availability	
Updating	Every 4 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **existence of updated documents on public use** will be considered and valuated as follows: • **Adequate**: if there is an individual updated* plan, programme or guidelines on public use in force → 2 points • **Moderate**: if there is an individual plan, programme or guidelines on public use but it is not updated or in force or it is integrated as general guidelines into articles or chapters in other plans or programmes → 1 point • **Deficient**: if there is no individual plan, programme or guidelines or general guidelines integrated into other plans or programmes → 0 points *Explanatory note* *A document is considered "not updated" when it is older than its stipulated enforcement period or, if that period is not specified, the document or plan is over 5 years old.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if it is the same in the two assessments and *negative* if the most recent value is lower than the previous one
References	• Decreto 143/2002, de 1 de agosto, por el que se aprueba la revisión del Plan de Ordenación de los Recursos Naturales de El Regajal-Mar de Ontígola. • Decreto 178/2002, de 14 de noviembre, por el que se aprueba el Plan de Ordenación de los Recursos Naturales del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara y su Área de Influencia Socioeconómica. • Decreto 26/1999, de 11 de febrero, por el que se aprueba el Plan de Ordenación de los Recursos Naturales para el Curso Medio del Río Guadarrama y su entorno. • Decreto 124/2002, de 5 de julio, por el que se aprueba la ampliación del Plan de Ordenación de los Recursos Naturales del Parque Regional del Curso Medio del río Guadarrama y su entorno. • Decreto 27/1999, de 11 de febrero, por el que se aprueba el Plan de Ordenación de los Recursos Naturales del Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. • Acuerdo de 22 de mayo de 2003, del Consejo de Gobierno, por el que se aprueba definitivamente el Plan Rector de Uso y Gestión del parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Decreto 14 FEBRERO 1991, NUM. 5/1991. Declara refugio de fauna a la Laguna de San Juan y su entorno. • Decreto 9/2009, de 5 de febrero, por el que se aprueba el Plan Rector de Uso y Gestión del Parque Regional en torno a los Ejes de los Cursos Bajos de los Ríos Manzanares y Jarama. • Orden 14 DICIEMBRE 1992. Aprueba el Plan de Gestión del refugio de fauna de la Laguna de San Juan y su entorno. • Acuerdo de 20 de noviembre de 1995, del Consejo de Gobierno, por el que se aprueba la revisión del Plan Rector de Uso y Gestión del Parque Regional de la Cuenca Alta del Manzanares. • Barrado, D. 1999. *Actividades de ocio y recreativas en el medio natural de la Comunidad de Madrid. La ciudad a la búsqueda de la naturaleza*.

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2.6. Zoning	
Category	Planning
Type	Response
Description	This indicator assesses the division of the protected area into management zones with different administrative characteristics and protection levels.
Rationale	The division of large or complex protected areas into different zones with different degrees of regulation of activities allows more efficient management of the whole protected area by adapting management to the specific characteristics and needs of each zone. In any type of protected area, it is assumed that the existence of a buffer zone mitigates outer impacts on the core zone, which is the most fragile and valuable for conservation (Spellerberg, 1994; Pressey *et al*., 2007). Zoning is one of the minimum international standards for individual protected areas (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Every 5 years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **zoning** of the protected area will be considered and valuated as follows: • **Adequate**: if there are three legally established zones in the protected area: a core zone (which may be subdivided into different protection zones), a buffer zone and a zone of social and economic influence (which may be the same as the previous zone) → 2 points. • **Moderate***: if the protected area has at least two legally established zones: a core zone (which may be subdivided into different protection zones) and a buffer zone → 1 point. • **Deficient**: if the whole protected area corresponds to a single

	zone → 0 points. *Explanatory note* *Protected areas with different legally established protection zones will be considered 'moderate' even though they do not have a buffer zone. They will be valuated 1 point.
Tendency	The tendency will be *positive* if the protected area has diversified its zoning since the last assessment, *stable* if its zoning remains the same, and *negative* if the number of management zones has decreased between the two assessment dates.
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 15, 37 y 38. • Ley 23 ENERO 1985, NUM. 1/1985. Parque Regional de la Cuenca Alta del Manzanares. Capítulo IV. • Ley 6/1994, de 28 de junio, sobre el Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. Arts. 4 y 24. • LEY 7/2003, de 20 de marzo, de modificación de la Ley 6/1994, de 28 de junio, de Creación del Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. • Ley 10 MAYO 1990, NUM. 6/1990. Declaración del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara. Arts. 4 y 5. • Decreto 143/2002, de 1 de agosto, por el que se aprueba la revisión del Plan de Ordenación de los Recursos Naturales de El Regajal-Mar de Ontígola. • Decreto 26/1999, de 11 de febrero, por el que se aprueba el Plan de Ordenación de los Recursos Naturales para el Curso Medio del Río Guadarrama y su entorno. • Decreto 124/2002, de 5 de julio, por el que se aprueba la ampliación del Plan de Ordenación de los Recursos Naturales del Parque Regional del Curso Medio del río Guadarrama y su entorno. • Decreto 27/1999, de 11 de febrero, por el que se aprueba el Plan de Ordenación de los Recursos Naturales del Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. Arts. 3 y 8. • Orden 14 DICIEMBRE 1992. Aprueba el Plan de Gestión del refugio de fauna de la Laguna de San Juan y su entorno. • Acuerdo de 22 de mayo de 2003, del Consejo de Gobierno, por el que se aprueba definitivamente el Plan Rector de Uso y Gestión del parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Spellerberg, I.F. 1994. *Evaluation and Assessment for Conservation*. Chapman & Hall, London. • Múgica, M. y Gómez-Limón, J. (Coords.). 2002. *Plan de Acción para los espacios naturales protegidos del Estado español*. Fundación fernando González Bernáldez. Madrid. • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Pressey, R.L.; Cabeza, M.; Watts, M.E.; Cowling, R.M.; and Wilson, K.A. 2007. *Conservation planning in a changing world*. Trends in Ecology and Evolution 22 (11): 583-592. • Rodríguez-Rodríguez, 2012. Integrated networks. A territorial planning proposal for long-term biodiversity conservation in urban, densely-populated regions. The case of the Autonomous Region of Madrid, Spain. Journal of Environmental Planning and Management, 55: 667-683

2.7. Evolution of the area designated as protected	
Category	Planning
Type	Response
Description	This indicator assesses the evolution of the area of the protected area which is legally designated as protected
Rationale	The importance of size for the efficiency of conservation of protected areas (Pullin, 2002) and speculative pressures on land inside and in the surroundings of protected areas (Radeloff *et al*., 2010) make it necessary to analyse the evolution of the area of the protected areas legally designated as protected
Data source	
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **evolution of the area designated as protected** will be considered and valuated as follows: • **Adequate**: There has been an augmentation of the legally designated area of the protected area (including its buffer zone or zone of social and economic influence, whether they exist) since it was declared → 2 points • **Neutral**: The legally designated area has remained equal since its designation → 1 point • **Deficient**: There has been a reduction in the legally designated area of the protected area (including its buffer zone or zone of social and economic influence, whether they exist) since it was declared → 0 points *Explanatory note* The loss of net area by the protected area resulting from works or projects will not be considered, as long as it does not imply a legal re-classification of that area. If there has been a simultaneous increase and decrease in the legally designated area between the assessment date and the designation date of the protected area, the total added (or substracted) area will be calculated to value the indicator (adequate evolution, if the addition is higher than the substraction, or deficient evolution, if the substraction is higher than the addition)
Tendency	The tendency will be *positive* if the legally designated area has increased between the last date assessed and the previous assessment, *stable* if the area is equal for the last two assessments, and *negative* if the legally designated area has decreased between the last assessed date and the previous one
References	• LEY 7/2003, de 20 de marzo, de modificación de la Ley 6/1994, de 28 de junio, de Creación del Parque Regional en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. • LEY 23 ABRIL 1987, NUM. 2/1987. Amplía el Parque Regionalde la Cuenca Alta del Manzanares. • LEY 7 FEBRERO 1991, NUM. 1/1991. Modifica la Ley de 23 de enero 1985 (R. 1985/289), de creación del Parque Regional de la Cuenca Alta del Manzanares. • LEY 4 ABRIL 1991, NUM. 7/1991. PARQUES Y RESERVAS NATURALES. Ampliación del Parque Regional de la Cuenca Alta del Manzanares.

	• LEY 21 ABRIL 1993, NUM. 5/1993. PARQUES Y RESERVAS NATURALES. Modifica la Ley 4 abril 1991 (LCM 1991, 71), de ampliación del Parque Regional de la Cuenca Alta del Manzanares. • LEY 10/2003, de 26 de marzo, de modificación de la Ley del Parque Regional de la Cuenca Alta del Manzanares y de la Junta Rectora del Parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Decreto 143/2002, de 1 de agosto, por el que se aprueba la revisión del Plan de Ordenación de los Recursos Naturales de El Regajal-Mar de Ontígola. • Decreto 124/2002, de 5 de julio, por el que se aprueba la ampliación del Plan de Ordenación de los Recursos Naturales del Parque Regional del Curso Medio del río Guadarrama y su entorno. • Acuerdo de 22 de mayo de 2003, del Consejo de Gobierno, por el que se aprueba definitivamente el Plan Rector de Uso y Gestión del parque Natural de la Cumbre, Circo y Lagunas de Peñalara. • Pullin, A.S. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Radeloff, V.C.; Stewart, S.I.; Hawbaker, T.J.; Gimmi, U.; Pidgeon, A.M.; Flather, C.H.; Hammer, R.B.; and Helmers, D.P. 2010. *Housing growth in and near United States protected areas limits their conservation value*. PNAS 107 (2): 940-945.

III. Management: twelve indicators

3.1. Degree of characterization of the protected area	
Category	Management
Type	State
Description	This indicator assesses the degree of knowledge about the biotic, abiotic and social feautures of the protected area
Rationale	One of the first and main duties of a protected area manager should be the complete and updated characterization of its natural resources. The lack of knowledge on natural resources implies serious limitations for management and important risks for their effective conservation (Chape *et al*., 2008)
Data source	
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The characterization of the different features of the protected area will be valuated as follows: ▪ <u>Characterization of abiotic features</u>: *-Complete information on the abiotic features: 0.4 points* *Geology: 0.3 points -Edafology: 0.05 points -Lithology: 0.05 points -Geomorphology: 0.05 points -Altitudes: 0.033 points

	-Slopes: 0.033 points -Orientations: 0.033 points -Hidrology: 0.05 points *Climate: 0.1 points. -Temperature: 0.05 points -Precipitation: 0.05 points ▪ <u>Characterization of biotic features</u>: -*Complete information on bitoic features: 1.2 points* *Characterization of fungi populations: 0.1 point *Characterization of plant populations: 0.3 points -Cryptogams: 0.1 points -Fanerogams: 0.1 point -Vegetation: 0.1 point *Characterization of animal populations: 0.6 points -Invertebrates: 0.1 points -Fishes: 0.1 points -Amphibians: 0.1 points -Reptiles: 0.1 points -Birds: 0.1 points -Mammals: 0.1 points *Ecological characterization: 0.2 points -Habitats/ecosistems: 0.1 points -Landscapes: 0.1 points ▪ <u>Characterization of socioeconomic features</u>: -*Complete information on socioeconomic features: 0.3 points* -Land ownership: 0.1 point -Resident population: 0.1 point -Economic activities: 0.1 point ▪ <u>Characterization of historical and cultural features</u>: -*Complete information on historical and cultural features: 0.1 points* -Archeology: 0.05 points -History-etnology: 0.05 points The final score of the indicator will come from the simple addition of all the considered features (X). Thus, the **degree of characterization of the protected area** will be considered and valuated as follows: • **Adequate**: $1.4 \leq X \leq 2$ points → 2 points. When the sum of biotic features will be less than 1 point, the indicator value will descend one level (to moderate). • **Moderate**: $1.1 \leq X < 1.4$ points → 1 point. If the characterization of the biotic features is complete (1.2 points), the indicator value will ascend one level (to adequate). If the sum of biotic features is less than 0.7 points, the indicator value will descend one level (to deficient). • **Deficient**: $X \leq 1$ point → 0 points. If the sum of biotic features is ≥ 0.7 points, the indicator value will ascend one level (to moderate). *Explanatory notes*

	It is considered "complete information" on any feature the detailed characterization of that feature, independent of its lenght, in any planning or management document, or in any scientific or technical publication on the protected area. It is scored the total punctuation for that complete feature. It is considered "incomplete information" on any feature the partial characterization of that feature, or when that feature is characterised at a broader or finer scales than the area that feature covers within the PA. Should this be the case, only half of the total score of the considered feature will be given. If there is no information on the considered feature or this information is minimum or too diffuse, 0 points will be given.
Tendency	The tendency will be *positive* if the sum of the whole considered features is higher than in the previous assessment, *negative* if the sum of the biotic or socioeconomic features does not increase from the previous assessment or if, being this score maximum in both assessment dates, the information regarding any of those features has not been updated
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3.2. Degree of fulfilment of management objectives	
Category	Management
Type	Response
Description	This indicator assesses the degree to which the objectives programmed in the management documents of the protected area in force (workplan or similar) were achieved

Rationale	Global change poses important challenges to protected areas, necessitating active management to anticipate, prevent, mitigate or erase the pressures and threats to these areas. In order for this management to be really effective and adaptable to the changing needs of protected areas (Chape *et al*., 2008), it is essential to assess whether, during a defined period, the established management objectives have been fulfilled and to correct the causes of partial or total non-fulfilment (Múgica and Gómez-Limón, 2002; Mulero, 2002; Atauri *et al*., 2005; Hockings *et al*., 2006). The establishment and evolution of clearly defined, adaptable objectives allow managers to detect uncertainties and irregularities, to manage complex situations in a simple way with the support of science, to support and decentralize their decisions and to learn from their errors (Chape *et al*., 2008).
Data source	
Data availability	
Updating	Annual
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	If the management objectives are measurable, the percentage of fulfilment will be measured. If not, the main manager (director or similar) will be interviewed about the degree of fulfilment. The **degree of fulfilment of management objectives** (X) will be considered and valuated as follows: • **Adequate**: $X \geq 75\%$ for the year of assessment → 2 points • **Moderate**: $50\% \leq X < 75\%$ for the year of assessment → 1 point • **Deficient**: $X < 50\%$ for the year of assessment → 0 points *Explanatory note* "Management objectives" should be included in a written document, be this document public or internal. If such document does not exist, (workplan or similar, with a maximum validity period of 3 years), or when the PA has no appointed manager (director or similar) who can estimate globally the annual degree of fulfilment of its management objectives, the indicator will be valuated 0 points.
Tendency	The tendency will be *positive* if the value of the indicator is higher than the previous assessment, *stable* if it is the same in both assessments, and *negative* if it is smaller than the previous assessment
References	• Múgica, M. y Gómez-Limón, J. (Coords.). 2002. *Plan de Acción para los espacios naturales protegidos del Estado español*. Fundación Fernando González Bernáldez. Madrid. • Mulero, A. 2002. *La protección de espacios naturales en España (Antecedentes, contrastes territoriales, conflictos y perspectivas)*. Mundi-Prensa. Madrid. • Atauri, J.A.; Múgica, M.; De Lucio, J.V.; Castell, C. 2005. *Diseño de planes de seguimiento en espacios naturales protegidos*. Serie Manuales Europarc-España Nº 2. Fundación Fernando González Bernáldez. Barcelona. • Hockings, M.; Stolton, S.; Leverington, F.; Dudley, N.; andCourrau, J. 2006. *Evaluating effectiveness: A framework for assessing management effectiveness of protected areas*. 2nd Edition. IUCN. Gland, Swizerland y Cambridge, R.U. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*.

	Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA.

3.3. Evolution of the feature(s) for which the protected area was designated	
Category	Management
Type	Response
Description	This indicator assesses the tendency of the feature(s) determining the designation of the protected area, according to its designation norm
Rationale	The priority of any protected area should consist of improving the state of conservation of the feature/s which motivated its designation, as well as assessing its/their evolution in time, as the main indicator of the efficiency of the PA (Pullin, 2002; Cuevas, 2003)
Data source	
Data availability	
Updating	Annually or every two years for biotic features. Every three or five years for abiotic features
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	For each feature, a three-degree ordinal scale will be established. It will be valuated from 0 to 2 points: • **Positive tendency** of the feature: 2 points • **Stable tendency** of the feature: 1 point • **Negative tendency** of the feature: 0 points If there are different features, the results will be shown in a table. A weighted average in which biotic features will be scored double than abiotic features (X) will be done: $X = (\sum bf \times 2 + \sum af) / n1+n2)$, where bf: biotic features. af: abiotic features. n1: number of biotic features n2: number of abiotic features The global **evolution of the feature/s for which the PA was designated** will be considered and valuated as follows: • **Adequate**: 2 points • **Moderate**: 1 point • **Deficient**: 0 points *Explanatory note* It is considered "positive tendency" the increase in numbers or quality (>5%) of the considered feature since the designation of the protected area or the first available data. It is considered "stable tendency" the stabilization of the considered feature in terms of numbers or quality (+/- 5%) since the designation of the protected area or the first available data, or the oscillation of its value if no continuous tendency towards increase or decrease is observed (≥ 3 consecutive years).

	It is considered "negative tendency" the decrease in numbers or quality (< 5%) of the considered feature since the designation of the protected area or the first available data. For those features without previous data, the tendency will be considered "non aplicable" and valuated 0 points.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if it is the same in the two assessments, and *negative* if the most recent value is lower than the previous one
References	• Cessford y Muhar, 2003. *Monitoring options for visitor numbers in national parks and natural areas*. Journal for Nature Conservation, 11: 240-250. • Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Cuevas, J. A. 2003. *Inventario y Description de los hábitats incluidos en la Directiva 92/43/CEE presentes en la Comunidad de Madrid*. Serie Documentos nº 40. Centro de Investigaciones Ambientales de la Comunidad de Madrid Fernando González Bernáldez. Soto del Real. • Hockings, M.; Stolton, S.; Leverington, F.; Dudley, N.; and Courrau, J. 2006. *Evaluating effectiveness: A framework for assessing management effectiveness of protected areas*. 2nd Edition. IUCN. Gland, Swizerland y Cambridge, R.U.

3.4. Existence of sufficient management staff	
Category	Management
Type	Response
Description	This indicator assesses whether there is enough staff to manage the protected area
Rationale	The existence of a legally established management body allows professional, effective, responsible management of a protected area (Pomeroy *et al*., 2005). Management requires complete, continuous dedication, with rapid action to prevent sudden contingencies (Chape *et al*., 2008) and to ensure compliance with regulations (Pomeroy *et al*., 2005). Thus, the existence of sufficient staff is considered a basis for the effective management of protected areas (Múgica and Gómez-Limón, 2002; Carabias *et al*., 2004). Lack of sufficient staff is considered to be the commonest weakness of protected areas around the world (Leverigton *et al*., 2010; Nolte *et al*., 2010).
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The existence of fixed-position staff (independent of the type of contract) necessary for the effective management of the protected area, developing their jobs in the same protected area in the long term (not to cover temporal projects or needs) will be specified. The score of the indicator will be calculated from the simple addition of the score out of the presence of a director or technical manager, and the score out of the presence of surveillance staff in the protected area, depending on the type of protected area.

	a) <u>For protected areas without zoning</u>: The <u>existence of a director/technical staff</u> will be assessed and scored as follows: -There is, at least, one manager/technical person fully dedicated[1] to the PA, or two technical persons partially dedicated[2] to the protected area → 1 point; -There is one manager/technical person simultaneously dedicated to two protected areas (the same ones) and spending at least 75% of his/her worktime among them; or two technical persons spending at least 20% of their individual worktime to the (one) protected area→ 0.5 points; -There is no manager/technical person dedicated to the protected area; or there is one such person dedicated to more than 2 protected areas simultaneously (or dedicated only to 2, but changing protected areas); or there are two technical persons with a smaller wortime dedication than that of the previous paragraph → 0 points; The <u>existence of surveillance staff</u> will be assessed and scored as follows: -Regular surveillance staff[1] → 1 point -Irregular surveillance staff[1] → 0.5 points -Without surveillance or with sporadic surveillance → 0 points Both scores will be added up, so the **existence of sufficient management staff** (X) will be considered and valuated as follows: • **Adequate**: $2 \geq X \geq 1.5$ → 2 points • **Moderate**: $1.5 > X \geq 1$ → 1 point • **Deficient**: $X < 1$ → 0 points b) <u>For zoned protected areas</u>: The <u>existence of managing/technical staff</u> in the PA will be scored as follows: -More staff than described in the next point → 1 point -At least, 1 director, 1 public use technician, 1 conservation technician, and 2 administration persons → 0.5 points -Less staff than described in the previous point → 0 points The <u>existence of surveillance staff</u> will be assessed and scored as follows: -Regular surveillance staff[5] → 1 point -Irregular surveillance staff[6] → 0.5 points -Without surveillance or with sporadic surveillance → 0 points Both scores will be added, so the **existence of sufficient management staff** (X) will be considered and valuated as follows: • **Adequate**: $X > 1.5$ → 2 points • **Moderate**: $1.5 \geq X \geq 1$ → 1 point • **Deficient**: $X < 1$ → 0 points

	Explanatory note (for protected areas without zoning) [1]It is considered that a person is "fully dedicated" to the management of a PA when he/she dedicates at least 75% of his/her worktime to the protected area. [2]It si considered that a person is "partially dedicated" to the management of a protected area when he/she dedicates at least 40% of his/her worktime to the protected area. [3]It is considered as "regular surveillance" the patrol of the protected area at least 4 days per week. [4]It is considered as "irregular surveillance" the patrol frequency smaller than that of the previous point, but at least of 2 days per week. *Explanatory note (for zoned protected areas):* [5]It is considered as "regular surveillance" the patrol of the protected area 7 days a week. [6]It is considered as "irregular surveillance" the patrol of the protected area at least 5 days per week.
Tendency	The tendency will be *positive* if X increases between both analyzed periods, *stable* if X remains the same, and *negative* if X decreases
References	• Múgica, M. y Gómez-Limón, J. (Coords.). 2002. *Plan de Acción para los espacios naturales protegidos del Estado español*. Fundación Fernando González Bernáldez. Madrid. • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. *How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas*. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Leverington, F.; Lemos, K.; Courrau, J.; Pavese, H.; Nolte, C.; Marr, M.; Coad, L.; Burguess, N.; Bomhard, B.; & Hockings, M. 2010. *Management effectiveness evaluation in protected areas – a global study. Second Edition 2010*. University of Queensland. Brisbane. • Nolte, C.; Leverington, F.; Kettner, A.; Marr, M.; Nielsen, G.; Bomhard, B.; Stolton, S.; Stoll-Kleemann, S.; & Hockings, M. 2010. *Protected Area Management Effectiveness Assessments in Europe. A review of application, methods and results*. University of Greifswald. Greifswald, Germany.

3.5. Evolution of the investment in the protected area	
Category	Management

Type	Response
Description	This indicator assesses the evolution of the investment budget in the protected area
Rationale	The existence of sufficient, stable and enduring financing is fundamental for the efficient management of protected areas (Chape *et al*., 2008; Leverington *et al*., 2010; Mora and Sale, 2011). It is one of the minimum international standards for individual protected areas (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The evolution of the investment in the PA* will be measured since the designation of the protected area or since the first available data. The **evolution of the investment in the PA** will be considered and valuated as follows: • **Adequate**: when the average increase in the investment for the period of analysis (X) is equal or over +3% per annum, calculated on the same parameters and measurement methods → 2 points • **Moderate**: when +1% < X < +3% per annum, calculated on the same parameters and measurement methods. Punctual, non-consecutive investments in the last 3 years including the assessment year will also be considered "moderate" → 1 point • **Deficient**: when X < +1% per annum, calculated on the same parameters and measurement methods → 0 points *Explanatory note* *It will only be considered as "investment" the real investments in the protected area, not running costs or fixed costs. A 3% annual increase is applied as a standard reference of the inter-annual increase of prices (RPI).
Tendency	The tendency will be considered *positive* if there has been an inter-annual average increase equal or over +3% between the value of the last assessment and the value of the previous assessment. The tendency will be *stable* if X oscillates between +1% < X < +3% per annum between both dates, and it will be negative if X < 1% per annum in that period
References	• Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Leverington, F.; Lemos, K.; Courrau, J.; Pavese, H.; Nolte, C.; Marr, M.; Coad, L.; Burguess, N.; Bomhard, B.; & Hockings, M. 2010. *Management effectiveness evaluation in protected areas – a global study. Second Edition 2010*. University of Queensland. Brisbane.

	• Mora, C. and Sale, P.F. 2011. *Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea*. Marine Ecology Progress Series, 434: 251-266.

3.6. Effectiveness of the public participation bodies	
Category	Management
Type	Response
Description	This indicator assesses the existence of a public participation body and its effectiveness
Rationale	An adequate social representation and participation in the management of protected areas entails a deeper implication of society and a better aceptance of the management decisions. This affects notably and positively the effectiveness of management measures and thus, the effective conservation of protected areas (Pomeroy *et al*., 2005). Moreover, public participation is one of the minimum international standards for individual protected areas (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The effectiveness of the public participation bodies (PPB) will be considered and valuated according to the simple addition of the scores of its two constituent parameters as follows: -Regarding the *existence* of the PPB: • **Nonexistent**: There is no PPB for the protected area → 0 points. • **Existent**: There is a PPB for the protected area → its effectiveness will be assessed -Regarding its *effectiveness*: <u>For PAs without zoning</u>: • **Adequate**: More than one meeting every two years since the creation of the PPB or since the last assessment → 2 points • **Moderate**: One meeting every two years since the creation of the PPB or since the last assessment → 1 point • **Deficient**: Less than one meeting every two years since the creation of the PPB or since the last assessment → 0 points <u>For zoned protected areas</u>: • **Adequate**: More than one meeting per year since the creation of the PPB or since the last assessment → 2 points • **Moderate**: One meeting per year since the creation of the PPB or since the last assessment → 1 point • **Deficient**: Less than one meeting per year since the creation of the PPB or since the last assessment → 0 points
Tendency	The tendency will be considered *positive* if a PPB has been created or if the meeting frequency has increased since the last date analyzed. The tendency will be *stable* if both the existence and the meeting frequency are the same, and it will be *negative* if the PPB is eliminated or if the meeting frequency has decreased since the last date analyzed
References	• Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In

	Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

3.7. Production and distribution of an annual report on activities and outcomes	
Category	Management
Type	Response
Description	This indicator assesses the making and adequate distribution of a periodical report on the activities and outcomes of the protected area
Rationale	The communication of the activities performed in protected areas allows the citizens to know what these activities are. It brings the society closer to protected areas and enhances their knowledge on these areas (Pomeroy *et al*., 2005, Múgica *et al*., 2010). Additionally, it represents an exercise of transparency focused at the improvement of management effectiveness and accountability (Múgica *et al*., 2010; Spangenberg, 2011)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **production and distribution of an annual report on activities and outcomes** will be considered and valuated as follows: • **Adequate**: A report on activities and outcomes is made and published annually or every two years, be this report individual or be it included in broader publications on protected areas, and it is made accessible to the public → 2 points • **Moderate**: A report on activities and outcomes is made periodically, but it is either not made accessible to the public, or its making/publication frequency is over two years, or it has not been published in the last three years → 1 point • **Deficient**: No report on activities and outcomes is made, be it individually or included in broader publications on protected areas, or it has been over 5 years since the last report was published → 0 points *Explanatory note* It is considered "accessible to the public" or "adequate distribution" if the report is edited and available for consultation, at least, in official buildings, visitor's centres or on the Internet.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if it is the same in both assessments, and *negative* if the most recent value of the indicator is lower than the previous one
References	• VVAA. 1999. *El Medio Ambiente en la Comunidad de Madrid.*

	Consejería de Medio Ambiente y Desarrollo Regional. Comunidad de Madrid. Madrid. • VVAA. 2006. *El Medio Ambiente en la Comunidad de Madrid 2003-2004*. Dirección General de Promoción y Disciplina Ambiental. Consejería de Medio Ambiente y Ordenación del Territorio. Comunidad de Madrid. Madrid. • VVAA. 2007. *El Medio Ambiente en la Comunidad de Madrid 2005*. Dirección General de Promoción y Disciplina Ambiental. Consejería de Medio Ambiente y Ordenación del Territorio. Comunidad de Madrid. Madrid. • VVAA. 2009. *El Medio Ambiente en la Comunidad de Madrid 2006-2007*. Dirección General de Promoción y Disciplina Ambiental. Consejería de Medio Ambiente, Vivienda y Ordenación del Territorio. Comunidad de Madrid. Madrid. • Sánchez-Herrera, F. 2003. (Coord.). *Reserva Natural El Regajal-Mar de Ontígola. Mariposas y sus biotopos. Lepidoptera (I). Memoria 2002*. Dirección General del Medio Natural. Consejería de Medio Ambiente y Ordenación del Territorio. Comunidad de Madrid. • Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. *How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas*. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • Sánchez-Herrera, F. 2005. (Coord.). *Reserva Natural El Regajal-Mar de Ontígola. Mariposas y sus biotopos. Lepidoptera (II). Memoria 2003*. Dirección General del Medio Natural. Consejería de Medio Ambiente y Ordenación del Territorio. Comunidad de Madrid. • Sánchez-Herrera, F. (Coord.). 2006. *Reserva natural El Regajal-Mar de Ontígola. Mariposas y sus biotopos. Lepidoptera (III). Memoria 2004*. Dirección General del Medio Natural. Consejería de Medio Ambiente y ordenación del Territorio. Comunidad de Madrid. Madrid. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • VVAA. 2008. *Informe de gestión. Parque Natural de Peñalara. Año 2008*. Consejería de Medio Ambiente, Vivienda y Ordenación del Territorio. Documento interno. • Múgica, M.; Martínez-Alandi, C.; Gómez-Limón, J.; Puertas, J.; Atauri, J.A.; y De Lucio, J.V.. 2010. *Anuario EUROPARC-España del estado de los espacios naturales protegidos 2009*. Fundación Fernando González Bernáldez. Madrid. • Spangenberg, J.H. 2011. *Sustainability science: a review, an analysis and some empirical lessons*. Environmental Conservation 38 (3): 275-287.

3.8. Easiness to identify the protected area	
Category	Management
Type	Response
Description	This indicator assesses the easiness to identify *in situ* the limits of the protected area
Rationale	An appropriate identification of protected areas, at least at the points of maximum influx of visitors, informs the visitor or the potential offender of the difference of developing his/her activity inside a protected area. It should favour an environmentally sound behaviour among visitors and thus, facilitate management and effective conservation of these areas. It is

	also one of the minimum international standards for individual protected areas (Carabias *et al*., 2004).
Data source	Visits
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The signaling of every sensitive point* will be assessed, scoring each sensitive point individually as follows: • The signaling identifies perfectly the protected area and it is homogeneous** → 2 points • There is signaling identifying the protected area, but it is not homogeneous → 1 point • There is no signaling identifying the protected area → 0 points The **easiness to identifify the protected area** will be considered and valuated as follows. The final value of the indicator will come from the average of the values of every sensitive point in the protected area (X): • **Adequate**: The signaling identifies the protected area perfectly in all its sensitive points, and it is homogeneous: $X \geq 1.5 \rightarrow 2$ points • **Moderate**: there is signaling in the protected area, but it is restricted to the main accesses to the protected area, or it identifies the protected area perfectly in all its sensitive points but it is not homogeneous: $1 \leq X < 1.5 \rightarrow 1$ point • **Deficient**: there is no signaling identifying the protected area: $X < 1 \rightarrow 0$ points *Explanatory note* *It is considered "sensitive points" those places inside or on the perimeter of the protectd area where relevant concentrations of visitors take place: accesses, picnic areas and visitors centres. **It is considered "homogeneous signaling" the signaling which fulfils the signaling requirements or standards established in the law, in protected area management documents or in the guidelines of the network it belongs to.
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable* if X is the same in both assessments, and *negative* if X is lower than the previous assessment
References	• Sánchez-Herrera, F. 2003. *Señalización de los Espacios Naturales de la Comunidad de Madrid. Extracto del Manual de Normas*. Dirección General del Medio Natural. Consejería de Medio Ambiente. Comunidad de Madrid. • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

3.9. Public use infrastructure

Category	Management
Type	Response
Description	This indicator assesses the existence of public use infrastructures adequate to the size of the protected area, and their maintenance
Rationale	Public use infrastructures presented in enough quantity, well-maintained and oriented to the type of visitors to protected areas allow to direct visitor influxes and to improve the quality of visits through information and interpretation (Hernández y Gómez-Limón, 2005; Ortega *et al*., 2006; Pascual, 2007). Appropriate infrastructures are one of the minimum international standards for individual PAs (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The value of the indicator will be calculated from the valuation of its two constituent variables: 1. Sufficient/limited/insufficient number (X) = 2/1/0 points. For all protectded areas, it is considered "sufficient number" the existence of, at least, an information pannel on the protected area in each sensitive point* (except in visitor centres): accesses (for all protected areas except parks) and picnic areas. Additionally, protected areas bigger than 1,000 hectares must have at least 2 picnic areas and one network of identified paths (their maintenance will not be valued). In the case of parks, they must also have a visitors centre. If there is not such centre but there exist the other infrastructures mentioned before 0.5 points will be given. If these other infrastructures are lacking or they are present in smaller numbers than previously stated, 0 points will be given. 2. Adequate/moderate/inadequate maintenance (Y) = 2/1/0 points. It is considered "inadequate maintenance" the public infrastructure whose conservation characteristics hamper its use: it is broken, unreadable (in case of pannels), or vandalized (it is painted, dirty, etc., as long as its deterioration severely hinders its understanding and/or its use by visitors. The maintenance of each public use infrastructure in each visited sensitive point will be valuated separately (2, 1 or 0 points). The final value of each sensitive point will be the average maintenance value of every infrastructure present in it. The final value for the protected area will be the average maintenance value of all its sensitive points (Y). It will be considered and valuated as follows: • Adequate: $Y \geq 1.5 \rightarrow 2$ points • Moderate: $1.5 > Y \geq 1 \rightarrow 1$ point • Inadequate: $Y < 1 \rightarrow 0$ points The **public use infrastructure** will be calculated as the average value (Z) of its two constituent variables (X and Y). It will be considered and valuated as follows: • **Adequate**: $Z \geq 1.8 \rightarrow 2$ points • **Moderate**: $1.8 > Z > 1 \rightarrow 1$ point • **Deficient**: $Z \leq 1 \rightarrow 0$ points

	Explanatory note *It is considered "sensitive points" the places inside or on the perimeter of the protected area where relevant concentrations of visitors take place: accesses, picnic areas and visitors centres.
Tendency	The tendency will be *positive* if Z is higher than in the previous assessment, *stable* if Z is the same in both assessments, and *negative* if Z is smaller than its previous value
References	• Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Hernández, J. y Gómez-Limón, J. 2005. *Manual sobre conceptos de uso público en los espacios naturales protegidos*. Fundación Fernando González Bernáldez. Madrid. • Ortega, J.; Gómez-Limón, J.; Rovira, P.; López-Claramunt, A.; y Gabaldón, J. E. 2006. *Evaluación del papel que cumplen los equipamientos de uso público en los ENPs*. Fundación Fernando González Bernáldez. Madrid. • Pascual, J. A. 2007. *La gestión del uso público en espacios naturales*. Miraguano Ediciones. Madrid. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

3.10. Existence of environmental education and volunteering activities	
Category	Management
Type	Response
Description	This indicator assesses the existence of programs and/or activities on environmental education and environmental volunteering in the protected area, and their regularity
Rationale	Environmental education and volunteering in protected areas are very efficient activities to increase public environmental awareness and to promote social kwoledge and valuation of the protected areas and their resources (Pullin, 2002). It is one of the minimum international standards for individual protected areas (Carabias *et al*., 2004)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The indicator will be calculated as follows: Regarding <u>environmental education (EE)</u>: • If regular* EE activities included in a plan or program are performed → 1.5 points • If sporadic EE activities not included in a plan or program are performed → 0.5 points • If no EE activities are performed → 0 points Regarding <u>environmental volunteering</u> (EV): • If regular* EV activities included in a plan or program are

	performed → 0.5 points • If sporadic EV activities not included in a plan or program are performed → 0.3 points • If no EV activities are performed → 0 points The total value of the indicator will be the simple addition (X) of the values out of both variables (EE + EV). Thus, the **existence of environmental education and volunteering activities** will be considerd and valuated as follows: ▪ **Adequate**: 1.5 ≤ X ≤ 2 points → 2 points ▪ **Moderate**: 0.5 ≤ X < 1.5 points → 1 point ▪ **Deficient**: X < 0.5 points → 0 points *Explanatory note* *It is considered "regular activity" the annual performance of that activity during the last 4 years at least. Under that frequency, the activities performed in the last 6 years are considered as "sporadic". If no activity has been performed in the last 3 years, the indicator will be considered as "Deficient".
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if it is the same in both assessments, and *negative* if the most recent value of the indicator is lower than the previous one
References	• Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

3.11. Sanctioning procedures	
Category	Management
Type	Response
Description	This indicator assesses, for a precise year, the number of the sanctioning procedures started against offences affecting the protected area, according to their seriousness, the zone where they take place, and the type of activity leading to the offence
Rationale	The number and seriousness of the sanctioning procedures initiated in a protected area may indicate the degree of aggression by the protected area or the efficiency in its prevention. Aplied to management, this indicator reflects this second approach (Múgica y Gómez-Limón, 2002).
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2

Calculation and interpretation	To valuate the indicator, the number of sanctioning procedures, their seriousness, the zone where they occur (if the protected area is zoned), and the activities sanctioned will be assessed. The number of sanctioning procedures initiated (N) will be considered and valuated as follows: • High: N ≥ 5 / 1,000 ha. x year → 0 points. • Medium: 2 ≤ N < 5 / 1,000 ha. x year → 1 point • Low: 0 ≤ N < 2 / 1,000 ha. x year → 2 points 0.25 points will be subtracted from the value of N for every *very serious* procedure initiated in the core zone, independent of the area affected, related to any of the following activities: -Construction, -Fires, -Solid waste dumping or liquid waste spilling, -Alien invasive species release, The final value of the indicator cannot be less than 0 points. 0.125 points will be subtracted from the value of N for every *serious* procedure initiated in the core zone, independent of the area affected, related to the previously mentioned activities. These calculations will also be made for any *serious* or *very serious* procedure initiated in non-zoned protected areas. Thus, the **sanctioning procedures** occurring in the protected area will be considered and valuated as follows: • **Few**: N ≥ 1.875 → 2 points • **Medium**: 0.875 ≤ N < 1.875 → 1 point • **Many**: N < 0.875 → 0 points *Explanatory note* For protected areas smaller than 1,000 ha., the valuation intervals of the number of procedures will be the same, independent of the area of the protected areas
Tendency	The tendency will be *positive* if N is higher than in the previous assessment, *stable* if N is the same in both assessments, and *negative* if N is lower than its previous value
References	• Múgica, M. y Gómez-Limón, J. (Coords.). 2002. *Plan de Acción para los espacios naturales protegidos del Estado español*. Fundación Fernando González Bernáldez. Madrid. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

3.12. Monitoring	
Category	Management
Type	Response

Description	This indicator assesses if there is some monitoring activity regularly performed on the whole protected area, on its resources or on its threats
Rationale	Monitoring activities allow knowing the continuous evolution of the condition of the resources of a protected area and the impact of management activities on those resources (Atauri *et al*., 2002). It is also one of the minimum international standards for individual protected areas (Carabias *et al*., 2004). It allows, on the one hand, improving the knowledge of the studied features and their temporal evolution. On the other, results from monitoring activities provide basic relevant information for the correct, adaptable and efficient planning and management of protected areas (Atauri *et al*., 2002; Múgica y Gómez-Limón, 2002; Pullin, 2002)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **monitoring** will be considered and valuated as follows: • **Adequate**: There exist monitoring activities* on the whole protected area or, at least, on the features for which the protected area was designated, on the features with a special conservation value and endangered, and on their main pressures and threats → 2 points • **Moderate**: There are monitoring activities on, at least, one conservation feature** of the protected area → 1 point • **Deficient**: No monitoring activities on the protected area, its resources, pressures or threats exist → 0 points *Explanatory note* *It is considered "monitoring activity" the studies or analyses made to the same feature with regularity not longer than 2 years. **It is considered "conservation feature" the whole protected area, its constituent features (species, habitats, land, cultural features, etc.), or any threat to any of those features or to the whole protected area.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable* if it is the same in both assessments, and *negative* if the most recent value of the indicator is lower than the previous one
References	• Atauri, J.A.; de Lucio. J.V. y Castell, C. 2002. *El papel de los indicadores en la gestión de los espacios naturales protegidos*. En Ramírez, L. (Coord.). *Indicadores ambientales. Situación actual y perspectivas*. Organismo Autónomo Parques Nacionales. Madrid. • Múgica, M. y Gómez-Limón, J. (Coords.). 2002. *Plan de Acción para los espacios naturales protegidos del Estado español*. Fundación Fernando González Bernáldez. Soto del Real, Madrid. • Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Carabias, J.; Boness, M.; De la Maza, J.; and Cadena, R. 2004. *Buiding capacity to manage protected areas in an era of global change*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK.

IV. Social and economic context: five indicators

4.1. Number of municipalities in the protected area	
Category	Social and economic context
Type	Pressure
Description	This indicator assesses the number of municipalities which are totally or partially included in the protected area
Rationale	The empirical evidence suggests that the smaller the number of municipalities included in a protected area, the easier its management and conservation will be due to the fewer number of actors and interests involved which leads to the limitation of its pressures and threats (Rodríguez-Rodríguez, 2008; VVAA, 2008)
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The total **number of municipalities included in the PA** will be added (X). It will be considered and valuated as follows: • **Adequate**: X = 1 → 2 points • **Moderate**: 2 ≤ X ≤ 5 → 1 point • **Deficient**: X > 5 → 0 points
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable* if X is the same in both assessments, and *negative*, if X is lower than its previous value
References	• Rodríguez-Rodríguez, D. 2008. *Los espacios naturales protegidos de la Comunidad de Madrid. Principales amenazas para su conservación*. Editorial Complutense. Madrid. E-Book. Disponible en: http://www.ucm.es/BUCM/ecsa/36254.php?id=187 [Visitada 07/04/2011]. • VVAA. 2008. *Primer Informe de Situación de la Red de Parques Nacionales a 1 de enero de 2007*. Organismo Autónomo Parques Nacionales. Ministerio de Medio Ambiente. Disponible en: http://reddeparquesnacionales.mma.es/parques/org_auto/informacion_general/red_informe.htm

4.2. Area provided for the protected area by municipalities under local Agenda 21	
Category	Social and economic framework
Type	Response
Description	This indicator assesses the area provided to the protected area by municipalities with local Agenda 21 established*
Rationale	The ultimate goal of Agenda 21 is achieving sustainable development at local level (Martínez-Vega *et al*., 2009). Therefore, it is assumed that the bigger the area inside a protected area where the principles of sustainability of Agenda 21 are applied in a planned manner, the easier its management and conservation will be as a result of a reduction of its pressures and threats
Data source	
Data availability	
Updating	Every two years
Scale	Ordinal scale, from 0 to 2
Calculation and	The total **area provided for the protected by municipalities under local**

interpretation	**Agenda 21** established will be added (X). It will be considered and valuated as follows: • **Adequate**: If X ≥ 75 % of the total area of the protected area → 2 points • **Moderate**: If 40% ≤ X < 75 % of the total area of the protected area → 1 point • **Deficient**: If X < 40% of the total area of the protected area → 0 points *Explanatory note* *It is considered "municipality with a local Agenda 21 established" the municipality which has, at least, an action plan legally approved
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable* if X is the same in both assessments, and *negative* if X is lower than its previous value
References	• UN Department of Economic and Social Affairs. Division for Sustainable Development. In: http://www.un.org/esa/dsd/agenda21/ • Agenda 21 Local. FIDA. En: http://www.fida.es/02_portada/agenda21/agenda21_cam01032007.htm • Martínez-Vega, J.; Echavarría, P.; González-Gascón, V.; and Martínez-Cruz, N. 2009. *Propuesta metodológica para el análisis de la sostenibilidad en la provincia de Cuenca*. Boletín de la AGE 49: 281-308.

4.3. Land ownership	
Category	Social and economic framework
Type	State
Description	This indicator assesses the percentage of land of the protected are owned by the state, be it by public institutions, bodies or enterprises
Rationale	The public ownership of the land inside a protected area is considered a strenght because it reduces the number of actors, interests and conflicts, thus notably facilitating its management (Mulero, 2002; VVAA, 2008)
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The total percentage of public land inside the protected area* (X) will be added. **Land ownership** will be considered and valuated as follows: • **Public**: X ≥ 75 % → 2 points • **Semi-públic**: 40% ≤ X < 75% → 1 point • **Private**: X < 40% → 0 points *Explanatory note* *All zones of the protected area will be considered.
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable* if X is the same in both assessments, and *negative* if X is lower than its previous value
References	• Mulero, A. 2002. *La protección de espacios naturales en España*. Mundi-Prensa. Madrid. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de*

	fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • VVAA. 2008. *Primer Informe de Situación de la Red de Parques Nacionales a 1 de enero de 2007*. Organismo Autónomo Parques Nacionales. Ministerio de Medio Ambiente. Disponible en: http://reddeparquesnacionales.mma.es/parques/org_auto/informacion_general/red_informe.htm

4.4. Main economic activities in the protected area	
Category	Social and economic context
Type	Pressure
Description	A meaningful form of describing this indicator was not found
Rationale	The state of conservation of a protected area may depend on the sustainability of the economic activities performed inside it or in its surroundings (VVAA, 2008)
Data source	
Data availability	
Updating	
Scale	
Calculation and interpretation	A meaningful form of measuring and interpreting this indicator was not found
Tendency	
References	• Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • VVAA. 2008. *Primer Informe de Situación de la Red de Parques Nacionales a 1 de enero de 2007*. Organismo Autónomo Parques Nacionales. Ministerio de Medio Ambiente. Disponible en: http://reddeparquesnacionales.mma.es/parques/org_auto/informacion_general/red_informe.htm

Even though a meaningful form of describing and measuring this indicator has not been found, this indicator is kept in the SIAPA due to its relevance as a way to promote its future development.

4.5. Land use changes	
Category	Social and economic context
Type	Pressure
Description	This indicator assesses the changes in land uses inside and in the surroundings of the protected area (1 km perimeter) since the designation of the protected area or the first available data
Rationale	Human-made land transformation towards artificial uses and the tendency towards natural afforestation in industrialized countries determine, among other biogeochemical fluxes, the tendencies of biodiversity (Fernández-González, 2002). The impacts of theses transformations on protected areas and their resources make it advisable to analyze the land use changes which have occurred inside and near protected areas (Spellerberg, 1994; Radeloff *et al*., 2010)

Data source	CORINE-Landcover
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The different zones of the protected area (if it is zoned) and its surroundings (1 km) will be discriminated to valuate changes: • In zoned protected areas: general zones are ordered according to their conservation value: 1. Core/Reserve zone (score land use change x 3) 2. Sustainable activity zone/s (score land use change x 2) 3. Buffer zone 4. Surroundings (1 km perimeter) The *total value of the land use changes in the protected area* (%) will be calculated as follows: ∑ ±* Zone 1(x 3) ± Zone 2 (x 2) ± Zone 3 ± surroundings. • In non-zoned protected areas, 2 zones will be considered: protected area and its surroundings. The *total value of the land use changes in the protected area* (%) will be calculated as follows: ∑ ± protected area (x 2) ± surroundings. The **land use changes** in the protected area and its surroundings will be considered and valuated as follows: • **Positive**: if the increase in the natural or ecological value of the integrated area (protected area + surroundings): 0→1; 1→2, is ≥ 1%. 2 points will be given • **Null**: if no substantial positive or negative changes have occurred (< 1% of the area of the protected area + surroundings). 1 point will be given • **Negative**: if the decrease in the natural or ecological value of the integrated area (protected area + surroundings): 2→1; 1→0, is ≥ 1%. 0 points will be given *Explanatory note* *The sign of each addend is determined by the type of change in that zone: positive (+) or negative (-). If changes of different sign take place, the result will be the addition of the positive changes and the subtraction of the negative changes, previously weighted accordingly to the zone where they occurred. The general criterion is that the evolution from natural-seminatural-artificial area (2→1→0) is negative and if it occurs inversely is positive (0→1→2). It is considered "natural areas" (2): forests, riversides, forested meadows, scrubland, rocky habitats, river courses and masses, and natural meadows and pastures. They are valued 2 points. It is considered "semi-natural areas" (1): Urban or artificial green zones, golf courses, agricultural land, meadows and pastures. They are valued 1 point. It is considered "artificial areas" *(0)*: urban, commercial, industrial, transport, mining, and rubbish dumping zones. They are valuated 0

	points.
Tendency	The tendency will be considered *positive*, if the total value of the land use changes is greater than in the previous assessment. The tendency will be *stable* if that value is the same, and it will be *negative* if that value if smaller than in the previous assessment
References	• Instituto Geográfico Nacional. Coberturas y Usos del Suelo. Corine Land Cover. Nomenclatura del CORINE LAND COVER al nivel 5º (CLC2000). En: http://www.ign.es/ign/layoutIn/coberturaUsoSuelo.do • Spellerberg, I.F. 1994. *Evaluation and Assessment for Conservation*. Chapman & Hall, London. • Fernández-González, F. 2002. *Indicadores de biodiversidad. El estado actual de la investigación*. En Ramírez, L. (Coord.). *Indicadores ambientales. Situación actual y perspectivas*. Organismo Autónomo Parques Nacionales. Madrid. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Radeloff, V.C., Stewart, S.I., Hawbaker, T.J., Gimmi, U., Pidgeon, A.M., Flather, C.H., Hammer, R.B., and Helmers, D.P., 2010. *Housing growth in and near United States protected areas limits their conservation value*. PNAS, 107: 940-945. • Rodríguez-Rodríguez, 2012. Integrated networks. A territorial planning proposal for long-term biodiversity conservation in urban, densely-populated regions. The case of the Autonomous Region of Madrid, Spain. Journal of Environmental Planning and Management, 55: 667-683

V. Social perception and valuation: four indicators

5.1. Degree of knwoledge on the protected area	
Category	Social perception and valuation
Type	State
Description	This indicator assesses the degree of knowledge on the protected area by local populations directly affected by its designation
Rationale	The degree of knowledge on protected areas by local populations has a positive effect on their valuation, making their management easier (Borrini-Feyerabend *et al*., 2004). The degree of knowledge on protected areas allows also estimating the efficiency of the information and communication measures by protected area managers
Data source	Survey among residents
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	A random, sistematic phone survey using the phone directory will be done to a sample of 30 residents who know the protected area X, and who live in the municipality(ies) included in the protected area X. If there are numerous municipalities included in the protected area, the sample of residents will be chosen accordingly to the population of a maximum of the three bigger municipalities included in the protected area.

	They will be asked *if they know the protected area X (full name), be it physically (because they have visited it), be it culturally (because they know it exists, and are able to place its limits approximately)*. The **degree of knowledge on the protected area** will be considered and valuated accordingly to the percentage of positive responses over the total number of responses (Y) as it follows: • **High**: Y ≥ 75 % → 2 points • **Moderate**: 75% > Y ≥ 50% → 1 point • **Low**: Y < 50 % → 0 points
Tendency	The tendency will be *positive* if Y is higher than in the previous assessment, *stable* if Y is the same in both assessments, and *negative* if Y is lower than its previous value
References	• Borrini-Feyerabend, G.; Kothary, A.; and Oviedo, G. (2004) *Indigenous and Local Communnities and Protected Areas: Towards Equity and Enhanced Conservation*. Gland, Switzerland and Cambridge, UK: IUCN. • Rodríguez-Rodríguez, D. 2009. Mitigación de los impactos del turismo en espacios naturales protegidos y mejora de su financiación a través de medidas económicas. El caso de la Comunidad de Madrid. Boletín de la AGE, 50: 217-238. • Rodríguez-Rodríguez, D. 2012. Perception, use and valuation of protected areas by local populations in an economic crisis context. Environmental Conservation, 39: 162-171.

5.2. Perception of the conservation state	
Category	Social perception and valuation
Type	State
Description	This indicator assesses the perception of the conservation state of the protected area by local populations directly affected by its designation
Rationale	The perception of the conservation state of a protected area by local populations reflects the perceived deviation with regard to the desired conservation state. It also reflects, indirectly, the perception on its management (Corraliza *et al*., 2002).
Data source	Survey to residents
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	A random, sistematic phone survey using the phone directory will be done to a sample of 30 residents who know the protected area X, and who live in the municipality(ies) included in the protected area X. If there are numerous municipalities included in the protected area, the sample of residents will be chosen accordingly to the population of a maximum of the three bigger municipalities included in the protected area. They will be asked *how they perceive the conservation state of the protected area X (full name)*. The following options will be given: Very well conserved; Well conserved; Moderately well conserved; Not very well conserved; or Poorly conserved. The **perception on the conservation state** will be calculated by adding the percentages of the responses correspondent to the categories "Very well conserved" and "Well conserved" over the total number of responses

	(Y). It will be considered and valuated as follows: • **Good**: Y ≥ 75 % → 2 points • **Moderate**: 75 > Y ≥ 50 % → 1 point • **Poor**: Y < 50 % → 0 points *Explanatory note* If it has been a long time since the respondent last visited the PA (over 3 years), the response will not be taken into account for the calculation of the indicator.
Tendency	The tendency will be *positive* if Y is higher than in the previous assessment, *stable* if Y is the same in both assessments, and *negative* if Y is lower than its previous value
References	• Corraliza, J.A.; Martín, R.; Berenguer, J.; y Moreno, M. 2002. *Los espacios naturales protegidos, escenarios de intervención psicosocial*. Intervención Psicosocial 11: 303-316. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Rodríguez-Rodríguez, D. 2012. Perception, use and valuation of protected areas by local populations in an economic crisis context. Environmental Conservation, 39: 162-171.

5.3. Personal importance	
Category	Social perception and valuation
Type	State
Description	This indicator assesses the importance given by residents to nearby protected areas
Rationale	The bigger the importance given by local populations to protected areas, the more positive attitude and behaviour towards them those populations will have, thus facilitating management (Pomeroy *et al*., 2005).
Data source	Survey to residents
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	A random, sistematic phone survey using the phone directory will be done to a sample of 30 residents who know the protected area X, and who live in the municipality(ies) included in the protected area X. If there are numerous municipalities included in the protected area, the sample of residents will be chosen accordingly to the population of a maximum of the three bigger municipalities included in the protected area. They will be asked *how important the PA X (full name) is for them*. The following options will be given: Very important; Important; Not very important; or Unimportant. The **personal importance** will be calculated by adding the percentages of responses corresponding to the categories "Very important" and "Important" over the total number of responses (Y). It will be considered and valuated as follows. • **High**: Y ≥ 75 % → 2 points

	• **Moderate**: 75 > Y ≥ 50 % → 1 point • **Low**: Y < 50 % → 0 points
Tendency	The tendency will be *positive* if Y is higher than in the previous assessment, *stable* if Y is the same in both assessments, and *negative* if Y is lower than its previous value
References	• Pomeroy, R.S., Parks, J.E.; and Watson, L.M. 2005. *How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas*. IUCN, Gland, Switzerland, and Cambridge, United Kingdom. • Rodríguez-Rodríguez, D. 2012. Perception, use and valuation of protected areas by local populations in an economic crisis context. Environmental Conservation, 39: 162-171.

5.4. Economic valuation of the protected area	
Category	Social perception and valuation
Type	State
Description	This indicator assesses the opinion of local residents on 3 variables which determine their economic valuation of the nearby protected area: 1) the public (state) financing of the PA; 2) their willingness to pay to conserve the protected area or to improve it environmentally; and 3) their willingness to accept the establishment of an entrance fee to the protected area
Rationale	The willingness to pay (directly or indirectly) of local populations to conserve or improve protected areas estimates in the most precise and objective forms their valuation of these protected areas (Azqueta *et al*., 2007). A high valuation of protected areas will determine a more positive attitude and behaviour towards them
Data source	Survey to residents
Data availability	
Updating	Every five years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	A random, sistematic phone survey using the phone directory will be done to a sample of 30 residents who know the protected area X, and who live in the municipality(ies) included in the protected area X. If there are numerous municipalities included in the protected area, the sample of residents will be chosen accordingly to the population of a maximum of the three bigger municipalities included in the protected area. They will be asked if *they agree that the public (state) administrations spend a part of their budget on the conservation of the PA H (full name)*. The percentages of positive responses over the total (X) will be considered and valuated as follows: • High: X ≥ 75 % → 2 points • Moderate: 75% > X ≥ 50% → 1 point • Low: X < 50 % → 0 points Then, they will be asked if they *would be willing to pay higher taxes to conserve or improve the PA H environmentally*. The percentages of positive responses over the total (Y) will be considered and valuated as follows: • High: Y ≥ 75 % → 2 points • Moderate: 75% > Y ≥ 50% → 1 point • Low: Y < 50 % → 0 points Finally, they will be asked if they *would be willing to accept and entrance fee to the PA H*. The percentages of positive responses over the total (Z) will

	be considered and valuated as follows: • High: $Z \geq 75\ \% \rightarrow 2$ points • Moderate: $75\% > Z \geq 50\% \rightarrow 1$ point • Low: $Z < 50\ \% \rightarrow 0$ points The **economic valuation of the protected area** will be calculated as the simple average value of the 3 variables: $\sum (X+Y+Z)/3$. The result (W) will be considered and valuated as follows: • **High**: $1.33 \leq W \leq 2 \rightarrow 2$ points • **Moderate**: $1.33 > W \geq 1 \rightarrow 1$ point • **Low**: $W < 1 \rightarrow 0$ points
Tendency	The tendency will be *positive* if W is higher than in the previous assessment, *stable*, if W is the same in both assessments, and *negative* if W is lower than its previous value
References	• Brotherton, I. 1996. Protected Area Theory at the System Level. Journal of Environmental Management, 47: 369-379. • Azqueta, D.; Alviar, M.; Domínguez, L.; y O`Ryan, R. 2007. *Introducción a la economía ambiental*. Segunda edición. McGraw-Hill. Madrid. • Rodríguez-Rodríguez, D. 2009. Mitigación de los impactos del turismo en espacios naturales protegidos y mejora de su financiación a través de medidas económicas. El caso de la Comunidad de Madrid. Boletín de la AGE, 50: 217-238. • Rodríguez-Rodríguez, D. 2012. Perception, use and valuation of protected areas by local populations in an economic crisis context. Environmental Conservation, 39: 162-171.

VI. Threats to conservation: nine indicators

6.1. Presence of alien invasive species	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the presence of alien invasive species (AIS) in the protected area
Rationale	AIS are one of the most serious global threats to the conservation of biodiversity (Pullin, 2002; Pressey *et al*., 2007; Chape *et al*., 2008). The most serious impacts on native biodiversity are related to inter-specific interactions such as predation, parasitism, competence for resources, disease transmission, or to ecosystem`s modification (Díaz-Esteban, 2002)
Data source	
Data availability	
Updating	Annual
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **presence of alien invasive species*** will be considered and valuated as follows: • **Null**: There are no proved signs** of the existence of AIS in the protected area → 0 points • **Moderate**: There are proved signs of the existence of one AIS in the protected area → 1 point • **High**: There are proved signs of the existence of more than one AIS in the protected area → 2 points

	Explanatory note *It will be considered "AIS" the species included in the DAISIE European project as they are, by specialists consensus, the most dangerous to European biodiversity. **It will be considered "proved signs" the sightseeing of individuals, the unmistakable discovery of marks or footprints inside the protected area, and the inclusion of AIS in specialised bibliography on the protected area.
Tendency	The tendency will be considered *positive* if the number of AIS is smaller than in the previous assessment. The tendency will be considered *stable* is the number of AIS is the same in both assessments, and the tendency will be considered *negative* if the number of AIS is higher than in the previous assessment
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts., 3.13, 61, 76.f, y 77. • Ley 2/1991, de 14 de febrero, para la Protección de la Fauna y la Flora Silvestres en la Comunidad de Madrid. Arts. 1, 2, 22 y 45.4.i. • Ley 7/1990, de 28 de junio, de Protección de embalses y Zonas húmedas de la Comunidad Autónoma de Madrid. Art. 16. • VVAA. 1997. *Plan Rector de Uso y Gestión del Parque Regional de la Cuenca Alta del Manzanares*. Dirección General de Educación y Prevención Ambiental. Consejería de Medio Ambiente y Desarrollo Regional. Comunidad de Madrid. • Notario, A. (Coord.). 1998. *Plan Forestal de la Comunidad de Madrid. Programa de Protección y Manejo de la Fauna. Tomo III*. Consejería de Medio Ambiente y Desarrollo Regional. Comunidad de Madrid. Doc. Int. • VVAA. 2004. *Inventario piscícola para la gestión de los cotos trucheros de la Comunidad de Madrid*. Servicio de Protección de Flora y Fauna. Dirección General del Medio Natural. Consejería de Medio Ambiente y Ordenación del Territorio. CAM. Doc. Int. • Delibes, M. 2001. *Vida. La naturaleza en peligro*. Temas de hoy. Madrid. • Díaz-Esteban, M. 2002. *Elementos y procesos clave para el funcionamiento de los sistemas naturales: las Calculation and interpretations con significado funcional como alternativa a los indicadores clásicos*. En Ramírez, L. (Coord.). *Indicadores ambientales. Situación actual y perspectivas*. Organismo Autónomo Parques Nacionales. Madrid. • Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Pressey, R.L.; Cabeza, M.; Watts, M.E.; Cowling, R.M.; and Wilson, K.A. 2007. *Conservation planning in a changing world*. Trends in Ecology and Evolution 22 (11): 583-592. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • DAISIE. En: http://www.europe-aliens.org/index.jsp • Flora Ibérica. En: http://www.floraiberica.org/

6.2. Climate change	
Category	Threats to conservation
Type	Pressure

Description	This indicator assesses the variation in temperature and precipitation in the protected area as possible signs of climate change
Rationale	Climate change is a global threat which imposes rising direct and indirect pressures on protected areas and on their management (Barber, 2004; Chape *et al*., 2008; Nolte *et al*., 2010; Araújo *et al*., 2011). These pressures are linked to unusually-rapid changes in environmental parameters crucial for biodiversity to which some populations are not able to adapt leading to their extinction (Pullin, 2002; Mora and Sale, 2011)
Data source	
Data availability	
Updating	Every ten years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	In order to have comparatively long temporal series for the assessment, the average annual values of temperature and total precipitation of two consecutive periods of, at least, 10 years* will be compared. Data will be collected from the closest meteorological station/s to protected areas. Stations inside PAs will be preferred. Should these not be available, the 2 or 3 nearest stations will be considered, and an average will be done among their data for the two variables. For big protected areas, average data from at least the 2 closest stations will be considered. The indicator will be scored accordingly to its two constituent variables: *variation in the average annual temperature* for the two considered periods (X); and *average percentage of variation in precipitation* for the two considered periods (Y), as follows: • $X < +/- 0.33$ ºc → 0 points. • $+/-0.33$ ºc $\leq X \leq +/-0.5$ ºc → 1 point. • $X \geq +/-0.5$ ºc → 2 points. • $Y < +/- 5\%$ → 0 points. • $+/-5\% \leq Y < +/-10\%$ → 1 point. • $Y \geq +/-10\%$ → 2 points. The total value of the indicator (Z) will be calculated by adding the scores of its two constituent variables Z= (X+Y). Thus, the **climate change** will be considered and valuated as follows: • **Unlikely**: $Z = 0$ → 0 points • **Possible**: $1 \leq Z < 3$ → 1 point • **Likely**: $Z \geq 3$ → 2 points *Explanatory note* *If more temporal data are available, it is recommended to divide the whole series into two equal intervals (30 years preferred) as a means of comparison. If the frequency of the protected area assessment is every five years, the intermediate assessments of this indicator will be considered as "NA" (not applicable).
Tendency	The tendency will be considered *positive* if X and Y vary in an equal or inferior quantity than their lowest intervals (0 points) compared to the previous assessment. The tendency will be considered *stable* if X and Y are within the intermediate intervals in both assessment periods, or if one of the variables increases its value (to an upper inteval) and the other

	variable decreases (to a lower interval). The tendency will be considered *negative* if X and Y vary in an equal or superior quantity than their upper intervals (2 points) compared to the previous assessment
References	• Montero, J.L. y González, J.L. 1974. *Diagramas bioclimáticos*. ICONA. Madrid. • García, L. y Reija, A. 1994. *Tiempo y clima en España. Meteorología de las Autonomías.* Dossat-2000. Madrid. • Pita, Mª. F. y Aguilar, M. (Orgs.). 1994. *Cambios y variaciones climáticas en España*. Fundación El Monte. Sevilla. • Cuadrat, J.M. ; Vicente, S.M ; y Saz, M.A. (Eds.). 2002. *La información climática como herramienta de gestión ambiental. Bases de datos y tratamiento de series climatológicas*. Universidad de Zaragoza. Zaragoza. • Pullin, A. 2002. Conservation Biology. Cambridge University Press. Cambridge, UK. • Barber, C.V. 2004. *Designing protected area systems for a changing world*. In Barber, C.V.; Miller, K.R.; and Bones, M. (Eds.). *Securing Protected Areas in the Face of Global Change: Issues and Strategies*. IUCN. Gland, Switzerland and Cambridge, UK. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Araújo, M.B., Alagador, D., Cabeza, M., Nogués-Bravo, D. and Thuiller, W., 2011. *Climate change threatens European conservation areas*. Ecol. Lett. 14: 484-492. • Mora, C. and Sale, P.F. 2011. *Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea*. Marine Ecology Progress Series, 434: 251-266.

6.3. Area affected by fires	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the area (and the zone, if applicable) of the protected area affected by fires
Rationale	Forest fires are a natural phenomenon in the Mediterranean region (de Miguel y Díaz-Pineda, 2003; Chuvieco, 2009). However, some human variables, such as the number and frequency of visits to natural areas, the activities performed in these areas or the growth of the urban-forest interface may lead to an increase in the frequency of forest fires (Vilar *et al*., 2008; Chuvieco *et al*., 2010; Vilar *et al*., 2011) which may exceed the ecosystems resilience and lead to important changes in their structure and function. Also, fires inside protected areas are especially dangerous, due to the character of these areas as refuges of threatened biodiversity, and due to their limited size. As a result, fires inside protected areas may impact some populations as severely as to cause their extinction
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **area affected by fires** since the designation of the protected area or since the first available data will be considered and valuated as follows:

	In non-zoned protected areas: • **Low**: if the average percentage of the protected area affected by fires (X), calculated as the addition of the hectares affected by fires in the last two years divided by the total number of hectares of the protected area (x 100), has affected an area of a maximum of 5% of the area of the protected area → 0 points. • **Moderate**: if 5% < X ≤ 10% of the total area of the protected area → 1 point. • **High**: if X > 10% of the total area of the protected area → 2 points. In zoned protected areas: • **Low**: if the average percentage of the protected area affected by fires (X), calculated as the addition of the hectares affected by fires in the last two years divided by the total number of hectares of the PA (x 100), has affected an area of a maximum of 5% of the area of the protected area, including a maximum of 2% of the core zone* → 0 points. • **Moderate**: if 5% < X ≤ 10% of the total area of the protected area or the percentage of the core zone affected by fires (Y) is: 2% < Y ≤ 5% → 1 point. • **High**: if X > 10% of the total area of the protected area or Y > 5% → 2 points. *Explanatory note* *It is considered "core zone" the nuclear zone of the protected area with the highest conservation value, independent of its name: core zone, reserve zone, etc. Y is calculated the same as X, but considering only the area of the core zone and of the hectares affected by fires inside it.
Tendency	The tendency will be considered *positive* if the average number of hectares affected by fires in the last 2 years of the analyzed period is smaller than the average number of the 5 years immediately prior to the last two years analysed. The tendency will be *stable* if those values are equal, and it will be *negative* if the average number of hectares affected by fires in the last 2 years is higher than the average number of the 5 previous years
References	• Ley 43/2003, de 21 de noviembre, de Montes. Arts. 1, 2.3, 3, 4, 5, 6, 7.2.i, 43, 55 y 56. • De Miguel, J.M. y Díaz-Pineda, F. 2003. *Medio ambiente. Problemas y posibilidades*. En García-Delgado, J.L. (Dir.). *Estructura económica de Madrid*. Segunda edición. Consejería de Justicia e Innovación Tecnológica. Comunidad de Madrid. Madrid. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Vilar, L.; Martín, M.P. y Martínez Vega, J. 2008. Empleo de técnicas de regresión logística para la obtención de modelos de riesgo humano de incendio forestal a escala regional. *Boletín de la Asociación de Geógrafos Españoles*, 47: 5-29. • Chuvieco, E. 2009. *Earth Observation of Wildland Fires in Mediterranean Ecosystems*. Springer-Verlag. Berlin. • Chuvieco, E; Aguado, I; Yebra, M; Nieto, H; Salas, J; Martín, M.P; Vilar, L; Martínez Vega, J; Martín, S; Ibarra, P; de la Riva, J; Baeza, J; Rodríguez, F; Molina, J.R; Herrera, M.A; y Zamora, R. 2010. *Development of a framework for fire danger assessment using Remote*

	Sensing and Geographic Information System technologies. Ecological Modelling, 221: 46-58. • Vilar, L; Martín, M.P; y Martínez Vega, J., 2011. *Logistic regression models for human-caused wildfire risk estimation: analysing the effect of the spatial accuracy in fire occurrence data*. European Journal of Forest Research, DOI: 10.1007/s10342-011-0488-2.

6.4. Fragmentation	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the degree of fragmentation of the natural habitats in the protected area
Rationale	Fragmentation of natural habitats is one of the main global causes of biodiversity loss due to its impacts on the loss of habitats and on the loss of quality of habitats (Fernández-González, 2002; Pullin, 2002; Chape *et al*., 2008; Nolte *et al*., 2010)
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The fragmentation of the protected area X will be calculated accordingly to its two constituent variables: "percentage of natural habitats[1] in the protected area" and "perimeter / relative area ratio[2]". They will be considered and scored as follows: • Percentage of natural habitats in the protected area (Y): $Y \geq 90\% \rightarrow 0$ points $90\% > Y \geq 80\% \rightarrow 1$ point $Y < 80\% \rightarrow 2$ points If Y = 100%, the final score of the indicator will be 0 points, as there are no artificial areas in the protected area. If Y < 100%, the existing percentage of the following types of artificial areas causing fragmentation will be substracted: -*Urban areas* -*Railways* -*Roads* • Ratio perimeter / relative area (Z): $Z \leq 1.38$[3] $\rightarrow 0$ points $1.38 < Z \leq 2 \rightarrow 1$ point $Z > 2 \rightarrow 2$ points After calculating the area covered by artificial areas inside each protected area, their perimeters will be calculated. The perimeters of the artificial areas are added to the perimeter of the protected area to obtain the total or real perimeter of the protected area. Then, this figure will be divided by the area covered by natural habitats which was calculated previously, having as a result the real ratio Perimeter / Area (P / A). This figure will then be divided by the minimum theoretical P / A ratio for each protected area (without fragmentation). Thus, a non-fragmented protected area will have a Z = 1. This value will increase when the perimeter of artificial areas

	inside the protected area increase. The final score of the indicator (W) will be calculated by adding both scores (Y + Z). Thus, the **fragmentation** will be considered and valuated as follows: • **Low**: W = 0 → 0 points • **Moderate**: 1 ≤ W ≤ 2 → 1 point • **High**: W > 2 → 2 points *Explanatory notes* [1]It is considered "natural habitats" habitats entirely natural and also semi-natural habitats (Dir. 92/43/CEE) and, therefore, the classes 2, 3, 4 and 5 of CORINE LandCover. [2]The "perimeter / relative area ratio" is used to avoid errors in the interpretation of fragmentation due to the effect of the shape of the protected area. For instance, a protected area may have a high P/A and have low fragmentation due to its long shape. That way, the real P / A ratio is compared with the minimum possible P / A ratio according to the shape of the protected area. [3]The value of the median divides very little fragmented protected areas from other notably fragmented protected areas.
Tendency	The tendency will be considered as *positive* if the value of Y increases and the value of Z decreases compared to the previous assessment. The tendency will be *stable* if both values are equal or if both variables increase or decrease. It will be *negative* if Y is smaller and Z is bigger than in the previous assessment
References	• Directiva 92/43/CEE del Consejo, de 21 de mayo de 1992, relativa a la conservación de los hábitats naturales y de la fauna y flora silvestres. Art. 1.b. • Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 17.g, 19.g, 20 y 46. • Fernández-González, F. 2002. *Indicadores de biodiversidad. El estado actual de la investigación*. En Ramírez, L. (Coord.). *Indicadores ambientales. Situación actual y perspectivas*. Organismo Autónomo Parques Nacionales. Madrid. • Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Nolte, C.; Leverington, F.; Kettner, A.; Marr, M.; Nielsen, G.; Bomhard, B.; Stolton, S.; Stoll-Kleemann, S.; and Hockings, M. 2010. *Protected Area Management Effectiveness Assessments in Europe. A review of application, methods and results*. University of Greifswald. Greifswald, Germany. • Rodríguez-Rodríguez, 2012. Integrated networks. A territorial planning proposal for long-term biodiversity conservation in urban, densely-populated regions. The case of the Autonomous Region of Madrid, Spain. Journal of Environmental Planning and Management, 55: 667-683

6.5. Isolation	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the degree of isolation of the protected area from other natural or semi-natural areas
Rationale	Isolation of protected areas results from the increase in artifical areas in their surroundings. It leads to additional pressures and threats on protected areas which limit their conservation effectiveness (Spellerberg, 1994; Pullin, 2002; Chape *et al*., 2008; Radeloff *et al*., 2010, Mora and Sale, 2011).
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **isolation** of the protected area will be considered and valuated as follows: • **Low**: the natural or semi-natural areas in the 500m-wide perimeter from the protected area (X) cover: X ≥ 90 % → 0 points • **Moderate**: 70 ≤ X < 90% → 1 point • **High**: X < 70 % → 2 points *Explanatory note* It is considered "natural areas": forests, riversides, forested meadows, scrubland, rocky habitats, river courses and masses, and natural meadows and pastures. It is considered "semi-natural areas": urban or artificial green zones, golf courses, agricultural land, meadows and pastures. It is considered "artificial areas": urban, commercial, industrial, transport, mining, and rubbish dumping zones. For the development of this indicator, the dispersal abilities of the most restricted taxa were considered: i.e. those taxa whose mobility is more limited, such as invertebrates, fishes, amphibians and reptiles. Thus, they require high physical connectivity among landscape units.
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable* if X is the same in both assessments, and *negative* if X is lower than its previous value
References	• Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Arts. 17.g, 19.g, 20 y 46. • Spellerberg, I.F. 1994. *Evaluation and Assessment for Conservation*. Chapman & Hall, London. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Radeloff, V.C., Stewart, S.I., Hawbaker, T.J., Gimmi, U., Pidgeon,

	A.M., Flather, C.H., Hammer, R.B., and Helmers, D.P., 2010. *Housing growth in and near United States protected areas limits their conservation value*. PNAS, 107: 940-945. • Mora, C. and Sale, P.F. 2011. Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. Marine Ecology Progress Series, 434: 251-266. • Rodríguez-Rodríguez, 2012. Integrated networks. A territorial planning proposal for long-term biodiversity conservation in urban, densely-populated regions. The case of the Autonomous Region of Madrid, Spain. Journal of Environmental Planning and Management, 55: 667-683

6.6. Accessibility	
Category	Threats to conservation
Type	Pressure
Description	This indicators assesses the proximity of the protected area to high-capacity transport infrastructures
Rationale	There exists a causal relationship between the proximity to transport infrastructures and the degree of threat to a protected area (Pressey *et al*., 2007; Chape *et al*., 2008; Nolte *et al*., 2010).
Data source	
Data availability	
Updating	Every four years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The **accessibility** to the protected area will be considered and valuated as follows: • **Low**: there is a high-capacity transport infrastructure* at 10 km or further from the perimeter of the protected area → 0 points • **Moderate**: there is a high-capacity transport infrastructure at less than 10 km from the perimeter of the protected area → 1 point • **High**: the protected area is crossed by at least one high-capacity transport infrastructure → 2 points *Explanatory note* **High-capacity transport infrastructure* includes highways and other roads of, at least, two lanes per direction.
Tendency	The tendency will be *positive* if the value of the indicator is higher than in the previous assessment, *stable*, if it is the same in both assessments, and *negative* if the most recent value of the indicator is lower than the previous one
References	• Pressey, R.L.; Cabeza, M.; Watts, M.E.; Cowling, R.M.; and Wilson, K.A. 2007. *Conservation planning in a changing world*. Trends in Ecology and Evolution 22 (11): 583-592. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm

	• Nolte, C.; Leverington, F.; Kettner, A.; Marr, M.; Nielsen, G.; Bomhard, B.; Stolton, S.; Stoll-Kleemann, S.; and Hockings, M. 2010. *Protected Area Management Effectiveness Assessments in Europe. A review of application, methods and results*. University of Greifswald. Greifswald, Germany.

6.7. Number of visitors	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the temporal variation in the number of visitors to the protected area
Rationale	High numbers of visitors amplify the number of impacts that visitors can have on protected areas and their resources (Chape *et al*., 2008). The most relevant among these impacts are: noise and disturbance to fauna; trampling, mutilation and uprooting of plants; colapse and degradation of public use infrastructures; littering; habitat destruction as a result of new visitors infrastructures; or higher risk of forest fires (Chape *et al*., 2008)
Data source	
Data availability	
Updating	Annually
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	In absence of precise figures on visitors to the protected area, the annual figures from visitors centres or from similar such centres will be considered. It was estimated that the percentage of total visitors to a protected area who visit the visitor centre ranges from 16.85% (de Lucio *et al*., 2008) to 19.94% (Ortega *et al*., 2006) (average = 17.14%). Consequently, to estimate the total number of visitors to a protected area, the following formula should be used: [Number of visitors x 100 / 17.41%). In order to compare figures among different protected areas, the total number of visitors to the protected area will be divided by its area (ha.), thus obtaining the density of visitors to the protected area (X). The **number of visitors** will be considered and valuated as follows for the last year with complete available data: • **Low**: X < 14 visitors / ha. x year[1] → 0 points • **Moderate**: 94 ≥ X ≥ 14 visitors / ha. x year → 1 point • **High**: X > 94 visitors / ha. x year[2] → 2 points *Explanatory note* [1]50% of the parks is visited by less than 14 visitors/ha. (Múgica *et al*., 2006). [2]To calculate a reference carrying capacity (CC), the average CC of the only protected area of the Region of Madrid having precise counting and control of visitors: the Natural Site of National Interest of Hayedo de Montejo de la Sierra, was considered: $_{Average}$CC= 85 visitors/ ha. x year (+ 10%) → $_{Maximum}$CC = 94 visitors /ha. x year The average number of visitors to this protected area (the entrance to which is restricted by daily quotas) was calculated for a 12-year period (1997-2008) and then divided by the total area of the protected area (in ha.). The resulting CC (85 visitors/ ha. x year) plus a 10% addition (CC = 94 vis. /ha. x year) seems an adequate general threshold in absence of

	other references, taking into account the fragility of the ecosystem present (beech forest in the limit of its distribution range) and the small size of this protected area (250 ha.).
Tendency	The tendency will be considered *positive* if the average number of visitors to the protected area in the last two years analysed is smaller than the previous five-year average number. The tendency will be considered as *stable* if both average numbers are equal, and it will be considered as *negative* if the previous five-year average number of visitors is higher than the average number for the last two years assessed
References	• Múgica, M.; Gómez-Limón, J.; de Lucio, J.V.; y Puertas, J. 2006. *Anuario EUROPARC-España del estado de los espacios naturales protegidos 2005*. Fundación Fernando González Bernáldez. Madrid. • Ortega, J.; Gómez-Limón, J.; Rovira, P.; López-Claramunt, A.; y Gabaldón, J.E. 2006. *Evaluación del papel que cumplen los equipamientos de uso publico en los espacios naturales protegidos*. Fundación Fernando González Bernáldez. Madrid. • De Lucio, J.V.; Múgica, M.; Gómez-Limón, J.; Martínez-Alandi, C.; Puertas, J.; y Atauri, J.A. 2008. *Anuario EUROPARC-España del estado de los espacios naturales protegidos 2007*. Fundación Fernando González Bernáldez. Madrid. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htmRodríguez-Rodríguez, D. 2009. Mitigación de los impactos del turismo en espacios naturales protegidos y mejora de su financiación a través de medidas económicas. El caso de la Comunidad de Madrid. Boletín de la AGE, 50: 217-238. • Rodríguez-Rodríguez, 2012. Integrated networks. A territorial planning proposal for long-term biodiversity conservation in urban, densely-populated regions. The case of the Autonomous Region of Madrid, Spain. Journal of Environmental Planning and Management, 55: 667-683

6.8. Activities performed by visitors	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the main types of activities performed by visitors to protected areas to valuate the degree of threat these activities pose on the protected area or its resources
Rationale	Recreational activities are the most frequent and serious threat to the protected areas in industrialised countries (Rodríguez-Rodríguez, 2008; Leverington *et al*., 2010; Nolte *et al*., 2010). The more recreational activities are performed, the higher the number of incidents inside protected areas occur (Chape *et al*., 2008)
Data source	
Data availability	
Updating	Every two years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The three main activities performed by visitors to the protected area will be considered.

	• It will be considered "positive activities" the following ones. They will be scored 0 points: -Walking/trekking, -Relax/contemplation, -Nature photography, -Cycling, -Horse riding, -Canoeing or non-motor sailing. • It will be considered "neutral activities" the following ones. They will be scored 1 point: -Hunting (with licence), -Fishing (with licence), -Having lunch or playing in habilitated zones, -Motor activities in accesses, parking lots or authorised zones, -Walking with dogs, conveniently tied up, in authorised zones. • It will be considered "negative activities" the following ones. They will be scored 2 points: -Motor activities outside accesses, parking lots or authorised zones, -Collecting features of flora, fauna, geology, fungi or forest products, -Poaching, -Having lunch or playing in non-habilitated zones, -Walking with dogs, not tied up or outside authorised zones, -Littering or liquid waste spilling, -Degrading or destroying the patrimony, -Those activities prohibited by the legislation affecting the PA. The final score of the indicator will be the simple addition of the scores of every main activity performed (X). Thus, the **activities performed by visitors** to the protected area will be considered and valuated as follows: • **Positive**: they do not imply the degradation of the natural or cultural resources of the protected area: $X \leq 1 \rightarrow 0$ points • **Neutral**: they imply a light degradation of the natural or cultural resources of the protected area which does not jeopardize their conservation: $1 < X \leq 3 \rightarrow 1$ point. Within this interval, if any of these activities were "negative", the value of the indicator will descend one level. • **Negative**: they imply an important degradation of the natural or cultural resources of the protected area which jeopardizes their conservation: $X > 3 \rightarrow 2$ points *Explanatory note* If less than three activities are identified, the activities "not performed" will be scored 0 points.
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable* if X is the same in both assessments, and *negative* if X is lower than its previous value
References	• Barrado, D. 1999. *Actividades de ocio y recreativas en el medio natural de la Comunidad de Madrid. La ciudad a la búsqueda de la naturaleza*. Consejería de Medio Ambiente. Comunidad de Madrid. Madrid. • VVAA. *Cuadernos del Arboreto Luis Ceballos. Nº 2*. Consejería de Medio Ambiente, Vivienda y Ordenación del Territorio. Comunidad de Madrid.

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6.9. Local population density	
Category	Threats to conservation
Type	Pressure
Description	This indicator assesses the population density in the municipalities included in the protected area
Rationale	The higher the population density inside a protected area or in its surroundings is, the bigger and more numerous pressures on the protected area or on its resources will be (Spellerberg, 1994; Pullin, 2002; Mora and Sale, 2011). A high population density can also imply a higher frequency of incidents (Chape *et al*., 2008; Mora and Sale, 2011), and more difficulty in the implementation of law (Mora and Sale, 2011). As a result, it is an useful indicator on the interactions of the human beings with their environment (Ellis and Ramankutti, 2008)
Data source	
Data availability	
Updating	Every two years
Scale	Ordinal scale, from 0 to 2
Calculation and interpretation	The population residing in each of the municipalities included in the PA will be divided by the area of each municipality (km^2) thus obtaining the population density in that municipality. If there is more than one municipality included in the PA, the population densities for all the included municipalities will be calculated, each weighted by the

	percentage of the area covered by the PA in each of the municipalities. Finally, all these weighted densities will be simply added up to make up the **local population density** (X), which will be considered and valued as follows: • **Low**: $0 < X < 100$ inhabs./km^2* → 0 points • **Moderate**: $100 \leq X < 500$ inhabs./km^2 → 1 point • **High**: $X \geq 500$ inhabs./km^2 → 2 points *Explanatory note* *Definition of rural area by the EU according to population density.
Tendency	The tendency will be *positive* if X is higher than in the previous assessment, *stable*, if X is the same in both assessments, and *negative* if X is lower than its previous value
References	• Spellerberg, I.F. 1994. *Evaluation and Assessment for Conservation*. Chapman & Hall, London. • Pullin, A. 2002. *Conservation Biology*. Cambridge University Press. Cambridge, UK. • Chape, S.; Spalding, M.; and Jenkins; M.D. 2008. *The World's Protected Areas: Status, Values and Prospects in the 21st Century*. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA. • Ellis, E. C. and Ramankutty, N. 2008. *Putting people in the map: anthropogenic biomes of the world*. Frontiers in Ecology and the Environment 6 (8): 439-447. • Mallarach, J.M.; Germain, J.; Sabaté, X.; y Basora, X. 2008. *Protegits de fet o de dret? Primera avaluació del sistema d'espais naturals protegits de Catalunya*. Institució Catalana d'Història Natural. Disponible en: http://ichn.iec.cat/Avaluaci%C3%B3%20d%27espais.htm • Mora, C. and Sale, P.F. 2011. *Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea*. Marine Ecology Progress Series, 434: 251-266.